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(54) Title: PORTABLE COMPUTER SYSTEM WITH MODULAR INTERCHANGEABLE COMPONENTS

(57) Abstract

A portable computer having modular interchangeable components including a compute module, a print module, a file server module and an auxiliary module. The compute module and the print module can be removably coupled to form a compact integral unit. Alternatively, the compute module can be removably coupled to the file server module and the auxiliary module to form an alternate compact integral unit. Additionally, the compute module can be removably coupled to the print module with the print module removably coupled to the file server module. The interchangeable aspect of the various embodiments provide a reconfigurable compact portable computer system.

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PORTABLE COMPUTER SYSTEM WITH MODULAR INTERCHANGEABLE COMPONENTS

This application claims the benefit of U.S. provisional application serial No. 60/078,749 filed March 16, 1998.

BACKGROUND

The present invention relates generally to computer systems and more specifically to portable computer systems.

Technological advances have enabled the development of small, lightweight portable computers. These portable computers can generally perform the same functions as traditional desk-top computers but are lighter weight and more compact than the desk-top versions. Portable computers are convenient because they allow computing work to be performed away from the home or office during travel. Portable computers are especially convenient in that they allow a user to take a full complement of software and stored documents with them as they travel.

Computer peripherals are commonly used in conjunction with desk-top computers. These peripherals exist in many different forms and perform many different functions. Some of the more common peripherals include printers, mass memory storage devices, modems and network connectors. Many of these peripherals are external components in that they have their own housings and are not incorporated within a computer's housing. These peripherals enhance the capabilities of a computer by allowing for the performance of additional applications. These additional applications are desirable for use in conjunction with both desk-top and portable computers.

Portable versions of some peripherals have been developed for use with portable computers. For example, portable printers and docking stations have been developed specifically for use with portable computers. While these portable peripherals enhance the applications of the portable computers, they also hinder the portability of these computers by significantly increasing the size of the system and the weight of the overall system. In an effort to limit the undesirable effects of the portable peripherals, modular

portable peripherals have been developed that can be directly connected to portable computers.

However, the modular peripherals currently available do not satisfy the varying requirements of portable computer users. A portable computer user's computing needs can vary from day to day. In some instances, the user may require one peripheral while in another instance the same user may require additional or completely different peripherals. For example, some applications will require the use of a printer in conjunction with a portable computer while other applications with require the use of additional memory or additional drives such as a CD-ROM drive in conjunction with a portable computer. Moreover, some applications will require the simultaneous use of both a printer and an additional drive such as a CD-ROM drive in conjunction with the use of a portable computer.

Current modular portable computer systems do not satisfy these requirements. The modular portable computer systems presently available only allow for a two-part system that does not offer interchangeable components. Some portable computers can be configured with removable printers, while others can be configured with removable docking stations. These systems are limited to the two-part systems described and do not offer interchangeable components.

Therefore, a modular portable computer system that includes interchangeable components is needed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front perspective view of a compute module of a preferred embodiment.

FIG. 2 is a front perspective view of a closed compute module of a preferred embodiment.

FIG. 3 is a top view of a closed compute module of a preferred embodiment.

FIG. 4 is a front view of a closed compute module of a preferred embodiment.

FIG. 5 is a front perspective view of a compute module and a print module of a preferred embodiment.

FIG. 6 is a bottom perspective view of a compute module and a print module of a preferred embodiment.

FIG. 7 is a front perspective view of a compute module coupled to a print module of a preferred embodiment.

FIG. 8 is a front perspective view of a closed compute module coupled to a print module of a preferred embodiment.

FIG. 9 is a top view of a keyboard of a preferred embodiment.

FIG. 10 is a rear perspective view of a print module of a preferred embodiment.

FIG. 11 is an exploded view of a print module of a first preferred embodiment.

FIG. 12 is an exploded view of a print module of a second preferred embodiment.

FIG. 13 is an exploded view of a print module of a third preferred embodiment.

FIG. 14 is an exploded view of a print module of a fourth preferred embodiment.

FIG. 15 is an exploded view of a print module of a fifth preferred embodiment.

FIG. 16 is an exploded view of a print module of a sixth preferred embodiment.

FIG. 17 is a front perspective view of a compute module, a file server module and an auxiliary module of a preferred embodiment.

FIG. 18. is a bottom perspective view of a compute module, a file server module and an auxiliary module of a preferred embodiment.

FIG. 19 is a rear perspective view of a file server module of a preferred embodiment.

FIG. 20 is a front perspective view of a file server module of a preferred embodiment.

FIG. 21 is a front perspective view of a compute module coupled to a file server module and an auxiliary module of a preferred embodiment.

FIG. 22 is a front perspective view of a closed compute module coupled to a file server module and an auxiliary module of a preferred embodiment.

FIG. 23 is a rear perspective view of an auxiliary module of a preferred embodiment.

FIG. 24 is a front perspective view of a compute module, a print module and a file server module of a preferred embodiment.

FIG. 25 is a bottom perspective view of a compute module, a print module and a file server module of a preferred embodiment.

FIG. 26 is a front perspective view of a compute module coupled to a print module coupled to a file server module of a preferred embodiment.

FIG. 27 is a front perspective view of a closed compute module coupled to a print module coupled to a file server module of a preferred embodiment.

FIG. 28 is a perspective view of a power adapter module of a preferred embodiment.

FIG. 29 is a perspective view of a compute module and an auxiliary keyboard of a preferred embodiment.

FIG. 30 is a perspective view of a keyboard of an alternative embodiment.

FIG. 31 is a partial sectional view taken along the line A-A of FIG. 30.

FIG. 32 is a partial sectional view of an alternative embodiment of the keyboard of FIG. 31.

FIG. 33 is a partial sectional view taken along the line B-B of FIG. 30.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

The present embodiment allows for the simultaneous integration of two or more modular components in differing configurations to form a portable computer system. For example, a compute module can be interchangeably coupled to a print module, or a file server module and an auxiliary module. Additionally, the compute module can be removably coupled to a print module while the print module is simultaneously coupled to a file server module. Coupling the compute module to the print module or the file server module creates a compact portable unit. Additionally, the compute module includes many ergonomic and user oriented features thereby

creating a portable computer system that is easy for a user to operate and provides improved user oriented features.

By way of example, FIGS. 1 and 2 show a compute module 10 that can be coupled to either a print module 40, as shown in FIG. 3 and/or a file server module 120 as shown in FIGS. 21 and 26 and described below. The compute module 10 preferably comprises a base housing 12, a keyboard 14, a display screen 16, a force plate pointer 18, a peripheral connector 20 (FIG. 6), an internal hard drive (not shown), a motherboard (not shown), a microprocessor (not shown), additional operating hardware (not shown), a battery (not shown) and peripheral connectors (not shown). The compute module 10 preferably has a total weight of less than three pounds. The preferred height of the compute module 10, in the closed position depicted in FIGS. 2 and 4 is 1.2 inches or less. The compute module 10 has a preferred length of 12.2 inches and a preferred width of 6.6 inches as shown in FIG. 3.

The base housing 12 preferably comprises a molded plastic enclosure that contains the internal hard drive, the motherboard, the microprocessor, the additional operating hardware and the battery as discussed below. According to an alternative embodiment, the base housing 12 can be constructed from titanium or magnesium or any combination of plastic, titanium or magnesium. The base housing 12 is sized and shaped so as to form a single integral unit when the compute module 10 is coupled to the print module 40 as shown in FIG. 7. Coupling the compute module 10 and the print module 40 involves both a mechanical coupling and an electrical coupling, as described below.

A keyboard 14 is attached to the base housing 12 and serves as the primary input mechanism for a user of the compute module 10. In a preferred embodiment, the keyboard 14 is formed integral to the base housing 12. The keyboard 14 includes the standard keys commonly used in personal computer keyboards. The keys preferably are sized and arranged to create a 19mm pitch between the keys. In a preferred embodiment, the keyboard 14 comprises a split keyboard with a central gap in a QWERT configuration.

The keyboard is preferably arranged to create left and right portions 302, 304 (FIG. 9). The left and right portions 302, 304 preferably comprise a plurality of keys, including standard alpha numeric keys and function keys. The plurality of keys are arranged in a plurality of longitudinal lines with the alpha numeric being grouped together in a plurality of longitudinal lines L1, L2, R1, R2 and the function keys being grouped together in one or more longitudinal lines F1, F2 (FIG. 9). The longitudinal lines L1, L2, F1 are preferably parallel to one another and the longitudinal lines R1, R2, F2 are preferably also parallel to one another. The left portion 302 preferably comprises the keys normally associated with an user's left hand and the right portion 304 preferably comprises the keys normally associated with a user's right hand. The keyboard 14 preferably comprises a space bar 308 that is curved and extends from the left portion 302 to the right portion 304. Alternatively, the keyboard can comprise a plurality of space bars with one space bar associated the left portion 302 and one space bar associated with the right portion 304.

The left and right portions 302, 304 preferably are laterally separated by a gap 306 formed between the portions. The size and shape of the gap 306 can vary depending upon the specific orientation of the left and right portions 302, 304. The gap 306 preferably includes one or more pointing devices 18 as described herein. In an alternative embodiment, the gap 306 can comprises one or more additional function or other dedicated keys.

The keyboard 14 preferably includes features including a chevron arrangement of the keys as shown in FIG. 9. The left portion 302 is preferably tilted with respect to a horizontal line H such that a first angle $\theta 1$ is created between longitudinal lines L1, L2 and horizontal line H. The right portion 304 is preferably tilted with respect to a horizontal line H such that a second angle $\theta 2$ is created between longitudinal lines R1, R2 and horizontal line H. The first and second angles $\theta 1$, $\theta 2$ are preferably between the range of 3 and 7 degrees. Alternatively, the first and second angles $\theta 1$, $\theta 2$ can be any degree. By tilting the left and right portions 302, 304, the keys can be fitted within an area having a smaller width than an area required to fit keys configured in a separated horizontal arrangement.

In a further preferred embodiment, a top surface 310 of the keyboard can be convex as shown in FIGs. 30, 31, 32, and 33. The top surface 310 preferably comprises a plurality of keys 312 and a keyboard housing 314. The keys 312 are preferably arranged such that the tops of the keys mirror the profile of the keyboard housing 314. This arrangement provides a substantially uniform profile of the top surface 310 of the keyboard. The top surface 310 can be convex in a first direction, resulting in a first convex cross section (along line A-A, FIG. 30) as shown in FIG. 31. In an alternative embodiment, the top surface 310 can be partially convex in a first direction, resulting in an inclined cross section as shown in FIG. 32. Alternatively, the top surface can be convex in a second direction, resulting in a second convex cross section (along line B-B, FIG. 30) as shown in FIG. 33. In a further alternative embodiment, the top surface 310 can be convex in both the first and second directions.

The arrangement of the keyboard 14 in such a manner enhances the design of the compute module 10 by reducing the stress on a user's hands and wrists, thereby making it easier for a user to operate.

According to a preferred embodiment, the keyboard 14 includes four arrow keys 13 as shown in FIG. 29. The four arrow keys 13 comprise the up, down, left and right arrow keys and are connected to the keyboard 14 through the use of a force plate or other rocker mechanisms as know by those skilled in the art. This arrangement of the arrow keys 13 allows enhanced operability of the keys by a user. Alternatively, the up and down arrow keys can be connected to a force plate while the left and right arrow keys comprise conventional keys as known by those skilled in the art.

According to an alternate embodiment, an auxiliary input device 15 may be included as shown in FIG. 29. The auxiliary input device 15 preferably comprises a numeric keypad including the keys commonly utilized in numeric keypads for desktop keyboards as well known by those skilled in the art. Alternatively, the auxiliary input device 15 can comprise a stylus input device, a tough pad, a mouse, a trackball, or other suitable input devices.

The auxiliary input device 15 preferably is slidingly attached to the base housing 12 such that it can be completely contained within the base housing 12 when it is in a closed position. For example, the auxiliary input device 15 can be positioned

beneath the keyboard 14 when the auxiliary input device 15 is in the closed position. The auxiliary input device 15 preferably can be opened by activating a mechanism that allows the auxiliary device 15 to slide out of the base housing. The mechanism is preferably similar to those mechanisms currently used to open CD-ROM drives as known by those skilled in the art. Alternatively, the auxiliary keyboard can be rotatably or foldably attached to the base housing.

A display screen 16 is attached to the base housing 12 to provide a visual interface to enable the user to effectively operate the compute module 10. The display screen 16 preferably comprises a liquid crystal display (LCD) as known by those skilled in the art. The display screen 16 preferably comprises a CSTN display or other similar passive matrix display as commonly known by those skilled in the art. Alternatively, the display screen 16 can comprise a TFT display or other active matrix display, a DSTN display or other passive matrix display or a reflective or edge-lit LCD display, all of which are known by those skilled in the art.

The size of the display screen 16 is preferably 9 inches wide by 4.5 inches high, thereby creating a preferred width to height ratio of 2 to 1. The display screen 16 preferably is pivotally connected to the base housing 12 so as to be opened, as shown in FIG. 7 and closed, as shown in FIG. 8. Closing the display screen 16 can protect the display screen 16 when it is not in use and increase the portability of the system by producing a more compact unit. The display screen 16 preferably includes display retention hooks 38 that engage a portion of the display base 12 to serve as a locking mechanism to ensure that the display screen 16 remains closed until the user chooses to open it. Any form of latching mechanism known by those skilled in the art can be used in place of the preferred display retention hooks 38 described herein.

The force plate pointer 18, provides an alternate means for the user to input data to the compute module 10. Devices of this type are commonly used in conjunction with the family of windows operating systems as known by those skilled in the art. The force plate pointer 18 preferably comprises a force plate such as those commonly use in conjunction with portable computers known by those skilled in the art. While a force point pointer 18 is shown, any form of input device such as touch

pad, a track ball, a mouse, a stick pointer or other pointing devices known by those skilled in the art can be alternatively used.

The connector 20, shown in FIG. 6, allows the compute module 10 to be electrically coupled to the print module 40 and/or a file server module 120 as discussed herein. The connector preferably allows for the bi-directional transfer of data and control signals between the compute module 10 and the print module 40 and/or the file server module 120. The connector 20 also preferably allows for the transfer of power between the compute module 10 and the print module 40 and the file server module 120, as described herein. The connector 20 is preferably movably attached to the base housing 12 such that movement in one or more directions is enabled, thereby allowing the connector to float or pivot somewhat. This movement facilitates the coupling of the compute module 10 to the print module 40 by facilitating the mating of connector 20 and connector 46 (FIG. 5) or connector 124 (FIG. 19), as described herein.

The microprocessor preferably comprises a programmable data processing unit implemented in a single integrated circuit. The microprocessor preferably comprises the compute module's central processing unit as known by those skilled in the art. The microprocessor enables the overall functioning of the compute module 10 by executing commands as required by computer readable software implemented in the compute module 10. The microprocessor preferably comprises an Intel Pentium™ microprocessor commonly known by those skilled in the art. Alternatively, the microprocessor can comprise any Intel™ or other microprocessor.

The internal hard drive allows computer readable program code to be implemented by the compute module 10 and allows the user to store additional software applications and documents within the compute module. Currently, the internal hard drive preferably comprises a 2.1 gigabyte hard drive as known by those skilled in the art. According to an alternate embodiment, the computer readable program code can be implemented within the compute module 10 and files can be stored though the use of any mass memory storage device such as floppy drive or a CD-ROM drive, as known by those skilled in the art.

The additional hardware elements preferably comprise the additional hardware needed to implement computer readable programs such as operating systems and software applications as known by those skilled in the art. The additional hardware elements essentially comprise those elements needed for the compute module to operate as a typical portable computer as known by those skilled in the art, including memory, bus structures, registers and connectors. The additional hardware elements preferably comprise 16 megabytes of random access memory (RAM) 16. Alternatively, the additional hardware elements can comprise 32 megabytes of RAM.

The battery preferably is contained within the base housing 12 and provides the power necessary to enable operation of the compute module 10 as described herein. The battery preferably comprises a lithium ion battery known by those skilled in the art. Alternatively, the batter can comprise any form of battery capable of providing the required power as known by those skilled in the art.

The motherboard preferably includes the microprocessor and one or more of the additional hardware elements described herein and comprises a printed circuit board or other arrangement as known by those skilled in the art. The motherboard preferably is connected to the internal hard drive and the connector 20 described herein and facilitates the implementation of computer readable program code in the form of software programs and the transfer of data and control signals via the connector 20.

The base housing 12 preferably includes an electrical connector (not shown) for connection with an external power supply for providing power to the computer module 10. The electrical connector can be coupled with the preferred power adapter module 200 (FIG. 28) and can comprise any suitable connect known by those skilled in the art.

The compute module 10 preferably includes power management circuitry that ensures that the battery is utilized in the most efficient manner, thereby extending the life of the battery. The power management circuitry serves to reduce the power consumption of the compute module 10 by preventing power from being supplied to components, such as the internal hard disk drive, when such a component is not being utilized or when it doesn't otherwise require power. The power management circuitry

is preferably implemented as a combination of hardware and software elements as known by those skilled in the art.

The base housing 12 preferably includes peripheral retention receptacles 22 for enabling the compute module 10 to be easily and repeatedly coupled to and uncoupled from the print module 40 and the file server module 120. The peripheral retention receptacles 22 receive peripheral retention hooks 44 from the print module 40 to enable the print module 40 to be easily coupled to and uncoupled from the compute module 10. Alternatively, other types of mechanical latching or coupling mechanisms known by those skilled in the art can be utilized to mechanically couple the compute module 10 and the print module 40.

The base housing 12 preferably includes peripheral retention cavities 26 for facilitating the registration of the compute module 10 and the print module 40 or the file server module 120 when they are to be connected together. The peripheral retention cavities 26 receive peripheral retention tabs 50 from the print module 40 or retention tabs 154 from an auxiliary module 150 and further serve to ensure that once the compute module 10 is coupled to another module, the integrity of both the mechanical and electrical connections are maintained. While preferred mechanical coupling mechanisms are described above, any form of mechanical latching or coupling mechanisms known by those skilled in the art can be utilized to couple the compute module 10 and the print module 40 or the file server module 120 as described herein.

The compute module 10 preferable includes standard ports, to enable common peripherals to be connected to the compute module 10 as desired. The standard ports preferably include a parallel port, two PS2 ports and a video output port. Each of these ports includes a connector as is well known by those skilled in the art.

The compute module 10 preferably includes speakers 24 to enhance the multimedia capabilities of the system by allowing for sound to be played through the compute module 10. The speakers 24 are of the type commonly incorporated into portable computers and can be integrated into the compute module 10 as known by those skilled in the art. The speakers 24 preferably are integrated into the housing

surrounding the display screen 16 but could also be integrated into the base housing 12.

The compute module 10 preferably includes a built-in modem (not shown) as known by those skilled in the art. The modem allows the compute module 10 to transmit and receive data over a telephone system via a modem connector. The modem connector allows the compute module 10 to be connected to a common telephone jack thereby connecting the compute module 10 to the telephone system. The modem connector preferably comprises a RJ 11 jack as known by those skilled in the art.

The compute module 10 preferably includes a PC card interface for receiving a PC card as known by those skilled in the art. The PC card interface preferably comprises a slot or cavity formed in the base housing 12 for receiving a type III PCMCIA card, and a connector configured to allow bi-directional exchanges of data and control signals between the microprocessor and motherboard and the PC card. Such connectors and configurations are well known by those skilled in the art.

The compute module 10 preferably includes a built-in cellular radio to enable wireless communications between the compute module 10 and a wireless communication station as known by those skilled in the art. The built-in cellular radio enables the compute module 10 to transfer data to and receive data from other resources without physically connecting to a telecommunications system or network. For example, the compute module 10 can be connected with other computers connected to the Internet and/or the world wide web.

Referring now to FIGS. 5 - 8 and 10 - 16, the print module 40 comprises a print housing 42, a first connector 46, a second connector 48, peripheral retention hooks 44, peripheral retention tabs 50 (FIG. 10), peripheral retention receptacles 51 (FIG. 6), a paper input 52 (FIG. 11), a paper output 54, a print cartridge 60, a print head 62 and additional printing hardware.

The print housing 42 preferably comprises a molded plastic enclosure that contains the print cartridge 60, the print head 62 and the additional printing hardware as described below. According to an alternative embodiment, the print housing 42 can be constructed from titanium or magnesium or any combination of plastic, titanium or

magnesium. The print housing 42 is sized and shaped so as to form a single integral unit when the print module 40 is coupled to the compute module 10 and/or the file server module 120 as described herein.

The first connector 46 can be mated with and performs the same functions as the connector 20 described above. The second connector 48 performs the same functions as the connectors 20, 46 and can be mated with a connector 124 (FIGS. 19 & 20) attached to the file server module 120. Connectors 46 and 48 are preferably electrically connected to allow the bi-directional exchange of data, control signals and power there-between. The connection of connectors 46 and 48 enables the bi-directional exchange of data, control signals and power between the compute module 10, the print module 40, the file server module 120 and the auxiliary module 150 when the compute module 10 is coupled to the print module 40 with the print module 40 coupled to the file server module 120 as described herein.

The peripheral retention hooks 44 provide for the mechanical coupling of the compute module 10 and the print module 40 as described herein. The peripheral retention receptacles 51 (FIG. 6) are similar to the peripheral retention receptacles 22 described herein. The peripheral retention receptacles 51 enable the mechanical coupling of the print module 40 and the file server module 120 as described herein. The peripheral retention tabs 50 further enhance the mechanical coupling of the compute module 10 and the print module 40, as described herein. While preferred mechanical coupling mechanisms are described above, any form of mechanical latching or coupling mechanisms known by those skilled in the art could be utilized to couple the compute module 10 and the print module 40 or the file server module 120 as described herein.

Referring now to FIG. 11, a preferred side feed print module 40 is shown. The print cartridge 60 holds ink which is fed to a printing head 62 and enables ink to be applied to paper 64 to generate printed pages. The printing head 62 and print cartridge 60 preferably comprise an ink jet printing mechanism as known by those skilled in the art. The printing head 62 moves back and forth on guiding rods 66 to apply ink across the width of paper 64. Transfer tube 68 enables power, control signals and ink to be transmitted to the printing head 62. The paper 64 preferably is fed to the print module

40 through the paper input 52. The paper 64 is fed out of the print module 40 through the paper output 54. Both the paper input 52 and the paper output 54 comprise slots in the print housing 42 that allow internal access to the print module 40.

Referring now FIG. 12, the same components as described above in reference to FIG. 11 can be used to implement a front feed print module 40 of an alternate embodiment as shown. The printing head 70, print cartridge 72, guiding rods 76, transfer tube 78 all operate and function as described above with respect to FIG. 11. The paper 74 is input through the paper input 73 located on the front portion of the print housing 79 and is output through the paper output 75 located on the back portion of the print housing 79.

Referring now to FIG. 13, an alternate embodiment of a side feed print module 40 is shown. A combination printing head and ink cartridge 80 moves on guiding rods 82, to transfer ink onto paper 84. A ribbon cable 86 enables power and control signals to be communicated to the printing head 80. The paper is input through paper input 83 and output through paper output 85.

Referring now to FIG. 14, the same components as described above in reference to FIG. 13 can be utilized to implement a front feed print module 40 as shown. The combination printing head and ink cartridge 90, guiding rods 92 and ribbon cable 96 all operate and function as described above. The paper 94 is input through paper input 93 and output through paper output 95.

Referring now to FIG. 15, an alternate embodiment of a side feed print module 40 is shown. A full width ink cartridge 100, similar to a laser printer cartridge, and well known by those skilled in the art is utilized to apply ink to the paper 102. The paper 102 is input through the paper input 101 and output through the paper output 103.

Referring now to FIG. 16, the same components as described above in reference to FIG. 15 can be utilized to implement a front feed print module 40 as shown. The full width ink cartridge 106 operates and functions as described above. The paper 108 is input through the paper input 107 and output through the paper output 109.

According to an alternate embodiment, a scan cartridge (not shown) can be inserted in place of any of the print cartridges described above. The scan cartridge allows the print module 40 to function as a scanner to transform an image or text into a digitized representation as known by those skilled in the art. The scan cartridge can enable both gray scale and color scanning.

According to an alternate embodiment, the print module 40 can include additional ports to enable connection of the print module 40 in additional configurations as desired. The print module 40 can include a parallel port to enable an alternate form of connection to a personal computer. The print module 40 can also include a power supply connector to allow for the connection of an external power supply.

The compute module 10 and print module 40 can be removably coupled as shown in FIGS. 7 and 8. The compute module 10 and print module 40 can be coupled by first engaging the peripheral retention tabs 50 and the peripheral retention cavities 26. The coupling can be completed by engaging the peripheral retention hooks 44 and the peripheral retention receptacles 22. The connectors 20 and 46 are simultaneously mated as the compute module 10 and print module 40 are coupled, thereby completing the electrical coupling.

By way of further example, FIGS. 17-18 and 21-22 show a compute module 10 and a file server module 120 that can be removably coupled as shown in FIG. 21. The compute module 10 is mechanically and electrically connected to the file server module 120. The compute module 10 includes the same components and performs the same functions as described above. The file server module 120 comprises a server housing 122, a connector 124 (FIGS. 19 & 20), and additional ports as described herein.

The server housing 122 comprises a molded plastic enclosure that includes a number of ports that enable the connection of the components described below. According to an alternative embodiment, the server housing 122 can be constructed from titanium or magnesium or any combination of plastic, titanium or magnesium. The connector 124 comprises the same configuration and performs the same functions as connectors 20, 46 and 48 as described herein. The connector 124 can be mated

with connector 20 to complete the electric coupling of the compute module 10 and the file server module 120.

The file server module 120 preferably includes a USB bay and connector for enabling the connection of a CD-ROM drive, a floppy drive, a hard drive or a battery to the file server module 120. Both the USB bay and the USB connector comprise common components well known by those skilled in the art. The CD-ROM drive, floppy drive, hard drive and battery also comprise common components well known by those skilled in the art.

The file server housing 122 preferably includes common ports to enable the connection of peripheral devices to the file server module 120. The common ports preferably include two PS2 ports, a parallel port, a serial port, a video output port, an audio input port, an audio output port, a headphone port and a RJ11 port as known by those skilled in the art. Each of these ports includes a suitable connector as known by those skilled in the art.

The file server module 120 preferably includes at least two PC card bays. The PC card bays allow PC cards to be easily coupled to the file server module 120. The PC card bays preferably comprise type III PCMCIA compatible ports. Such PCMCIA ports and cards are well known by those skilled in the art.

The file server module 120 preferably includes peripheral retention hooks 130 for coupling the file server module 120 to the compute module 10 or print module 40 as described herein. The file server module 120 preferably includes retention hooks 132 and a tab 134 for coupling the file server module 120 to the auxiliary module 150. While preferred mechanical coupling mechanisms are described above, any form of mechanical latching or coupling mechanisms known by those skilled in the art can be utilized to couple the file server module 120, to the compute module 10 and the auxiliary module 150 or the file server module 120 to the print module 40 as described herein.

The file server module 120 preferably includes an electrical connector for mating with the preferred power adapter module 200. The electrical connector can be configured to provide power to the compute module 10 and the print module 40 or to provide power to charge a battery connected to the file server module 120 or to

provide power to charge a battery included within the auxiliary module 150. The file server module 120 preferably includes an auxiliary connector (not shown) to enable the bi-directional exchange of power between the file server module 120 and the auxiliary module 150.

An auxiliary module 150 can also be coupled to the file server module 120 to form a compact and portable unit. The auxiliary module preferably comprises a housing 152 preferably comprising a molded plastic enclosure as described herein. According to an alternative embodiment, the auxiliary module housing 152 can be constructed from titanium or magnesium or any combination of plastic, titanium or magnesium. The auxiliary module 150 preferably includes retention receptacles (not shown) for receiving the retention hooks 132 and tab 134 to enable the file server module 120 and the auxiliary module 150 to be mechanically coupled. The auxiliary module 150 preferably includes an auxiliary connector (not shown) which can be coupled with the auxiliary connector on the file server module 120 for enabling the bi-directional transfer of power between the auxiliary module 150 and the file server module 120.

The auxiliary module 150 preferably includes retention tabs 154 for mating with the peripheral retention cavities 26 for facilitating the registration of the compute module 10 and the auxiliary module 150 when the file server module 120 and the auxiliary module 150 are connected with the compute module 10. The auxiliary module 150 is preferably shaped so as to function as a wrist rest when coupled to the file server module 120 and the compute module 10 as shown in FIG. 21. The auxiliary module is preferably sized and shaped to support the user's wrists.

In a preferred embodiment, the auxiliary module 150 also includes a battery charger module. The battery charger module preferably includes an electrical supply connector for connecting the batter charger module to a common wall mounted electrical outlet. The electrical supply connector can comprise a retractable electrical supply connector with or without an extension cord. The battery charger module preferably includes one or more connectors for connecting batteries from the compute module 10 or the file server module 120 to the battery charger module. The battery charger module preferably includes a transformer or other circuitry for converting the

AC power from the wall outlet to DC power having prescribed voltage and current ratings. In an alternate embodiment, the batter charger module preferably includes a power supply connector 156 (FIG. 23) for connection with an external power supply module such as the one shown in FIG. 28. The power supply connector 156 enables the batter charger module to receive power that has previously been converted to DC power having a prescribed voltage and current rating by an external power supply module.

Alternatively, the auxiliary module 150 could include a battery. The battery can be used to supply power to the compute module 10, the print module 40 and the file server module 120. The power can be transmitted to the modules 10, 40, 120 though the auxiliary connectors and connectors 20, 46, 48 and 124.

The file server module 120 can be connected to the auxiliary module 150 by engaging the retention hooks 132 and tab 134 of the file server module 120 and the retention receptacles of the auxiliary module 150 and the auxiliary connectors of both the file server module 120 and the auxiliary module 150. The auxiliary connectors are preferably coupled as the mechanical connections are made. Once coupled together, the file server module 120 and the auxiliary module 150 can be coupled with the compute module 10 by engaging the peripheral retention hooks 130 and the peripheral retention receptacles 22 and the auxiliary tabs 154 and the peripheral retention cavities 26.

Alternatively, the file server module 120 alone can be coupled to the compute module 10 by engaging the peripheral retention hooks 130, the retention hooks 132 and peripheral retention receptacles 22 to mechanically couple the modules 10, 120. Connectors 20 and 124 are preferably coupled simultaneously as the hooks 130, 132 and receptacles 22 are engaged thereby electrically coupling the modules 10, 120. The two modules 10, 120 are coupled to form a single integral unit. While preferred mechanical coupling mechanisms are described above, any form of mechanical latching or coupling mechanisms known by those skilled in the art can be utilized to couple the compute module 10, file server module 120 and the auxiliary module 150 as described herein.

As described above, both the print module 40 and the file server 120 can be interchangeably coupled to the compute module 10. Each module 40, 120 includes a connector 46, 124 for facilitating the electrical coupling to the compute module 10 and mechanical connectors for facilitating the mechanical coupling to the compute module 10.

By way of further example, FIGS. 24 and 25 show a compute module 10, as described above, a print module 40, as described above and a file server module 120, as described above, that can be coupled as shown in FIG. 26. The compute module 10 is mechanically and electrically coupled to the print module 40 and the print module 40 is mechanically and electrically coupled to the file server module 120. The compute module 10 is preferably electrically connected to the file server module 120 via connectors 46 and 48 on the print module 40. The compute module 10 and the print module 40 are preferably electrically coupled through the connection of connectors 20 and 46. The compute module 10 and the print module 40 are preferably electrically coupled to the file server module 120 through the connection of connectors 48 and 124.

The compute module 10 and the print module 40 are preferably mechanically coupled in the same manner as described above. The file server module 120 and the print module 40 are preferably mechanically coupled by engaging the peripheral retention hooks 130, retention hooks 132 and peripheral retention receptacles 51. The electrical coupling of the connectors 20 & 46 and 48 & 124 preferably occurs simultaneously with the mechanical coupling described herein.

The power adapter module 200 preferably supplies power to system. The power adapter module 200 preferably comprises a power housing 202, a power supply plug 204, a power supply cord 206, a power adapter plug 208, a power adapter cord 210, a power adapter cord retractor and power conversion components (not shown). The power supply plug 204 is preferably of the type of plug that can be mated with a common wall mounted outlet well known by those skilled in the art. The power supply cord 206 electrically connects the power supply plug 204 and the power conversion components. The power conversion components convert power from the wall outlet, typically 120 volts AC, to the required DC power having voltage and

current values as needed to power the system. The power conversion components preferably comprise a transformer or other means for converting power from AC to DC as known by those skilled in the art.

The power adapter cord 210 electrically connects the power conversion components to the power adapter plug 208. The power adapter cord retractor allows the entire length of the power adapter cord 210 to be contained within the power housing 202. The power adapter cord retractor preferably comprises a spring actuated system as well known by those skilled in the art. The power adapter plug 208 enables the power adapter module 200 to be connected to the compute module 10 or the file server module 120.

It is to be understood that a wide range of changes and modifications to the embodiments described above will be apparent to those skilled in the art and are contemplated. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of the invention.

We claim:

1. In a portable computer comprising an integral keyboard, the improvement comprising:

wherein the integral keyboard comprises:

a first set of keys tilted at a first angle with respect to a horizontal line; and

a second set of keys tilted at a second angle with respect to a horizontal line.

2. In a portable computer comprising an integral keyboard, the improvement comprising:

wherein the integral keyboard comprises:

a first set of keys; and

a second set of keys laterally separated from the first set of keys.

3. In a portable computer comprising an integral keyboard, the improvement comprising:

wherein the integral keyboard comprises:

a first set of keys tilted at a first angle with respect to a horizontal line; and

a second set of keys tilted at a second angle with respect to a horizontal line, the second set of keys being laterally separated from the first set of keys.

4. In a portable computer comprising an integral keyboard, the improvement comprising:

wherein a top surface of the integral keyboard is convex.

5. The invention of claims 1 or 3, wherein the first and second angles are equal.

6. The invention of claims 1 or 3, wherein the first angle is in the range of 3 to 7 degrees.

7. The invention of claims 1 or 3, wherein the second angle is in the range of 3 to 7 degrees.

8. The invention of claims 1 or 3, wherein the first and second angles are in the range of 3 to 7 degrees.

9. The invention of claims 1, 2, or 3, wherein the first set of keys are configured to form a 19mm pitch between the keys.

10. The invention of claims 1, 2, or 3, wherein the second set of keys are configured to form a 19mm pitch between the keys.

11. In a portable computer comprising a housing and an integral keyboard, the improvement comprising:

an auxiliary input device slidably coupled with the housing.

12. The invention of claim wherein the auxiliary input device comprises a numeric keypad.

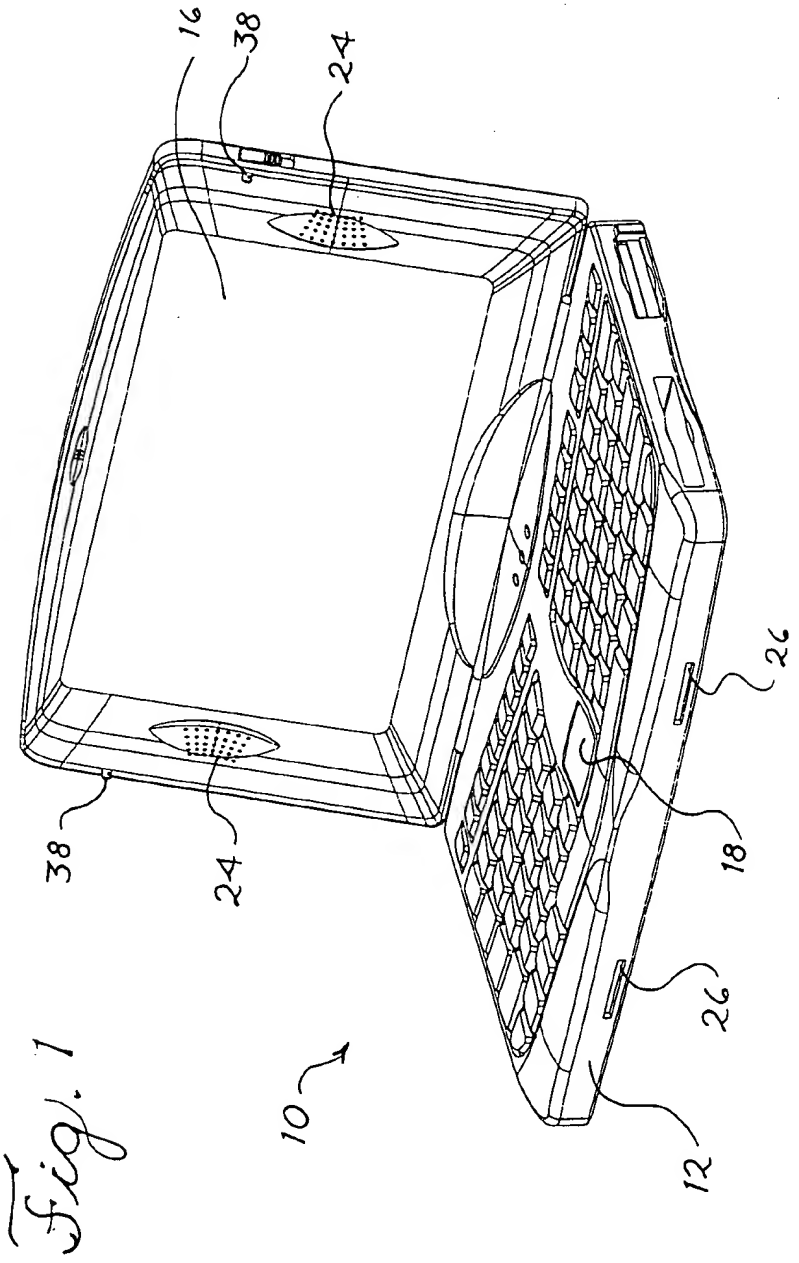


Fig. 1

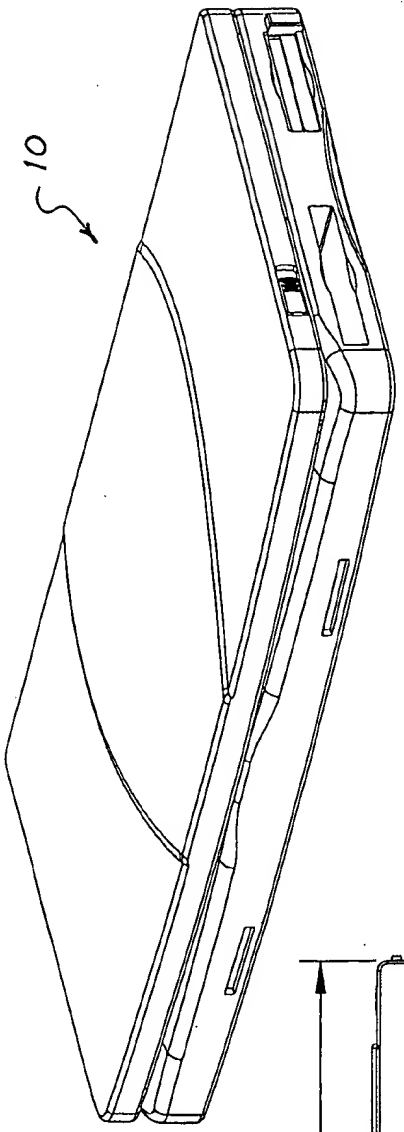


Fig. 2

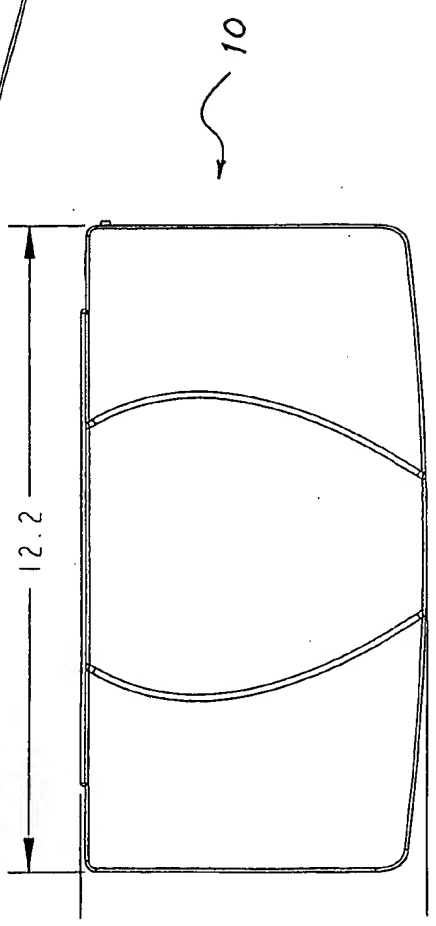


Fig. 3

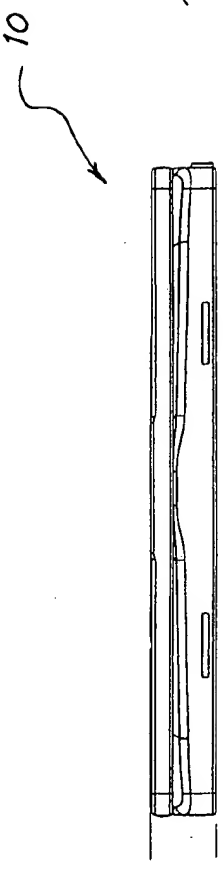


Fig. 4

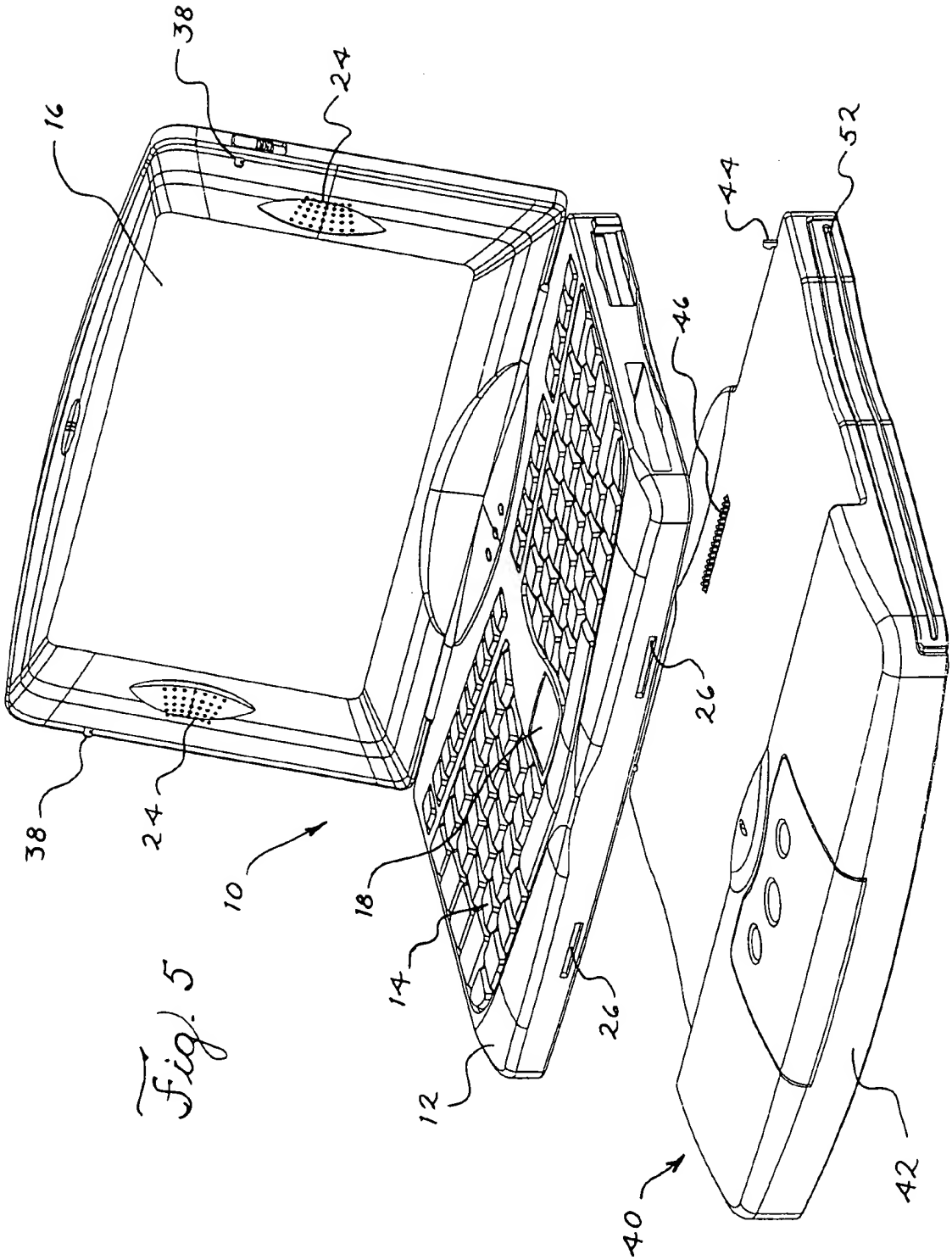


Fig. 5

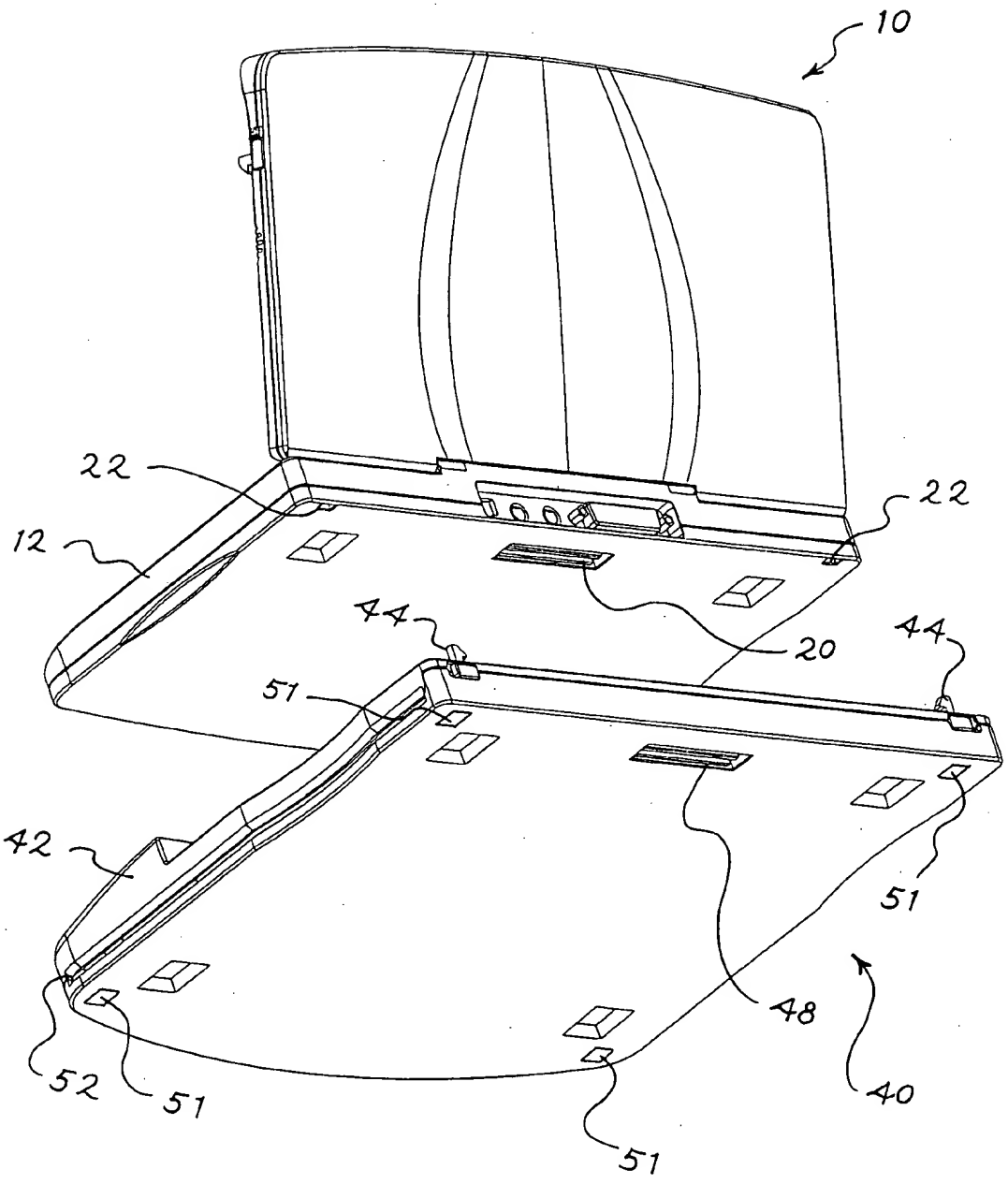


Fig. 6

Fig. 8

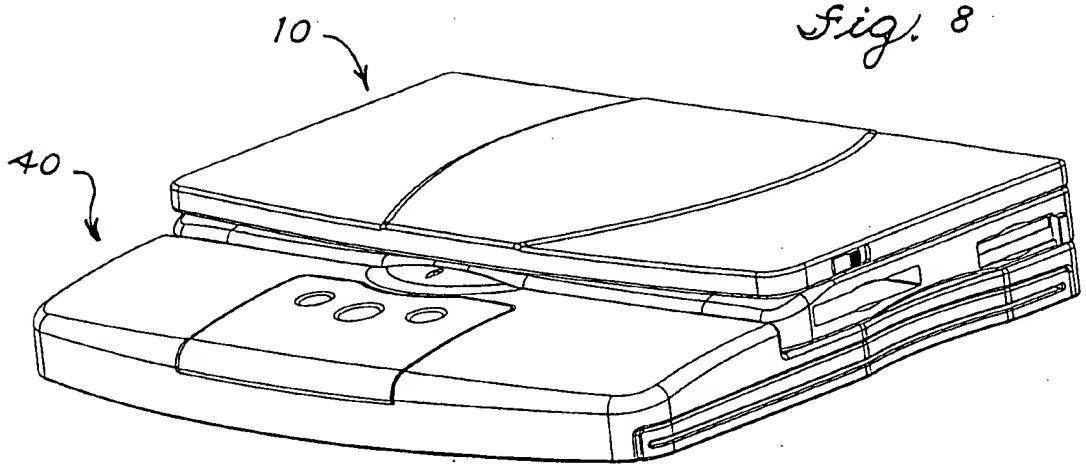


Fig. 7

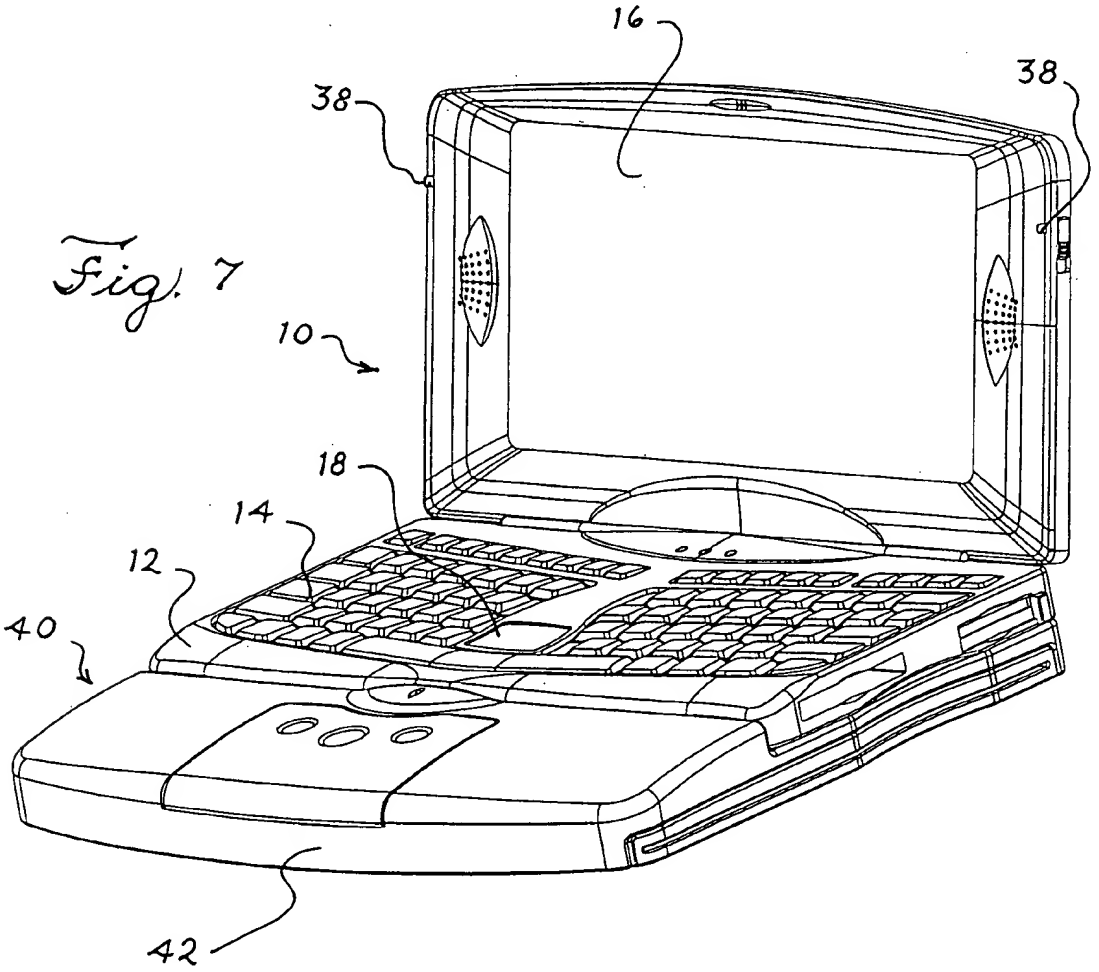


Fig. 9

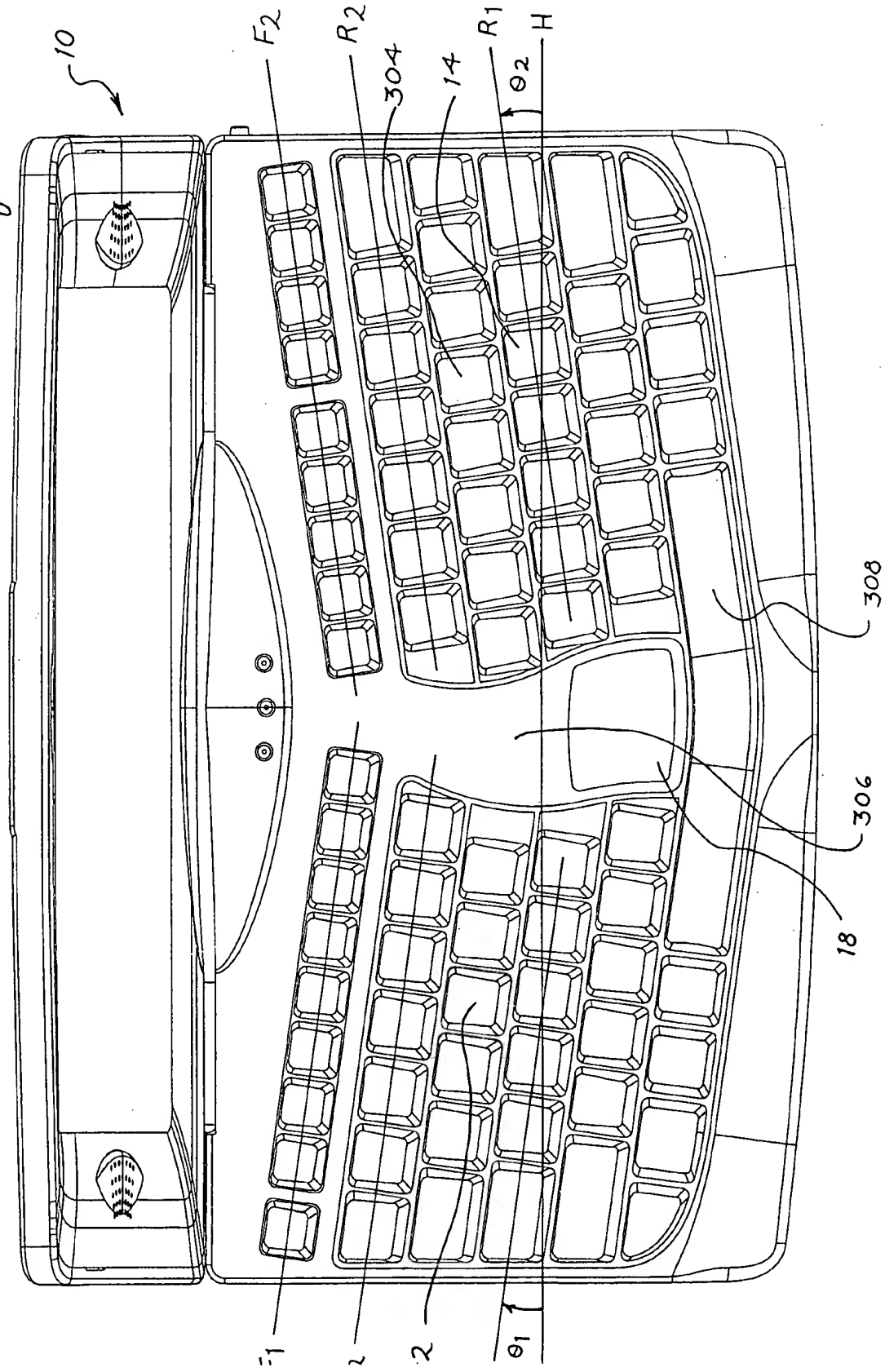


Fig. 10

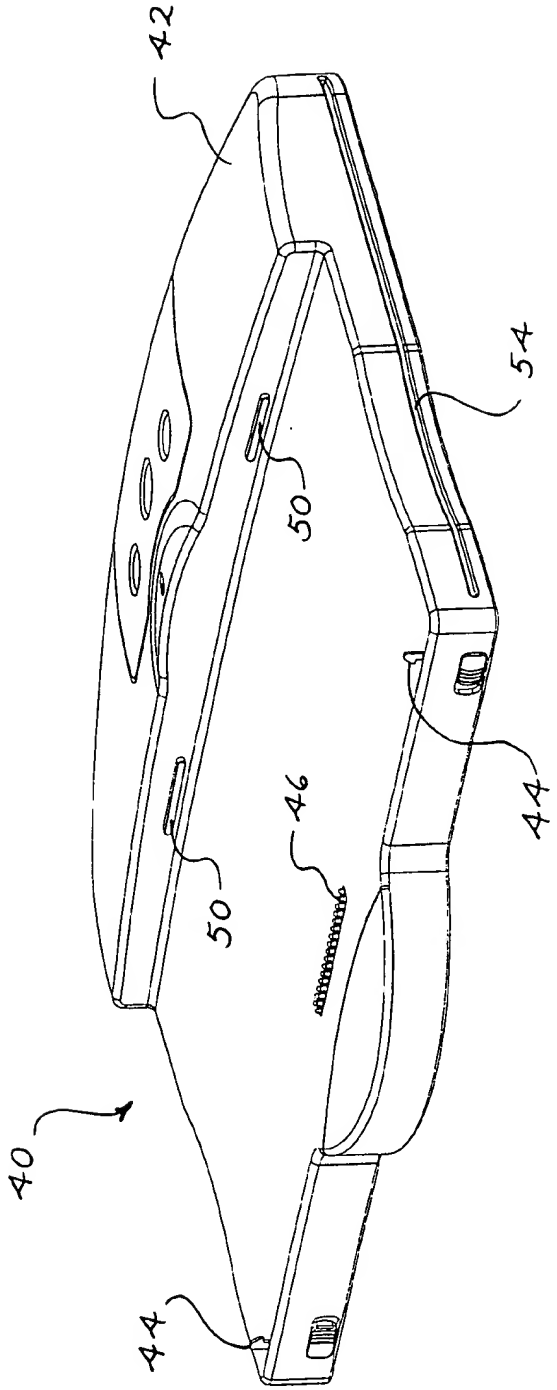


Fig. 11

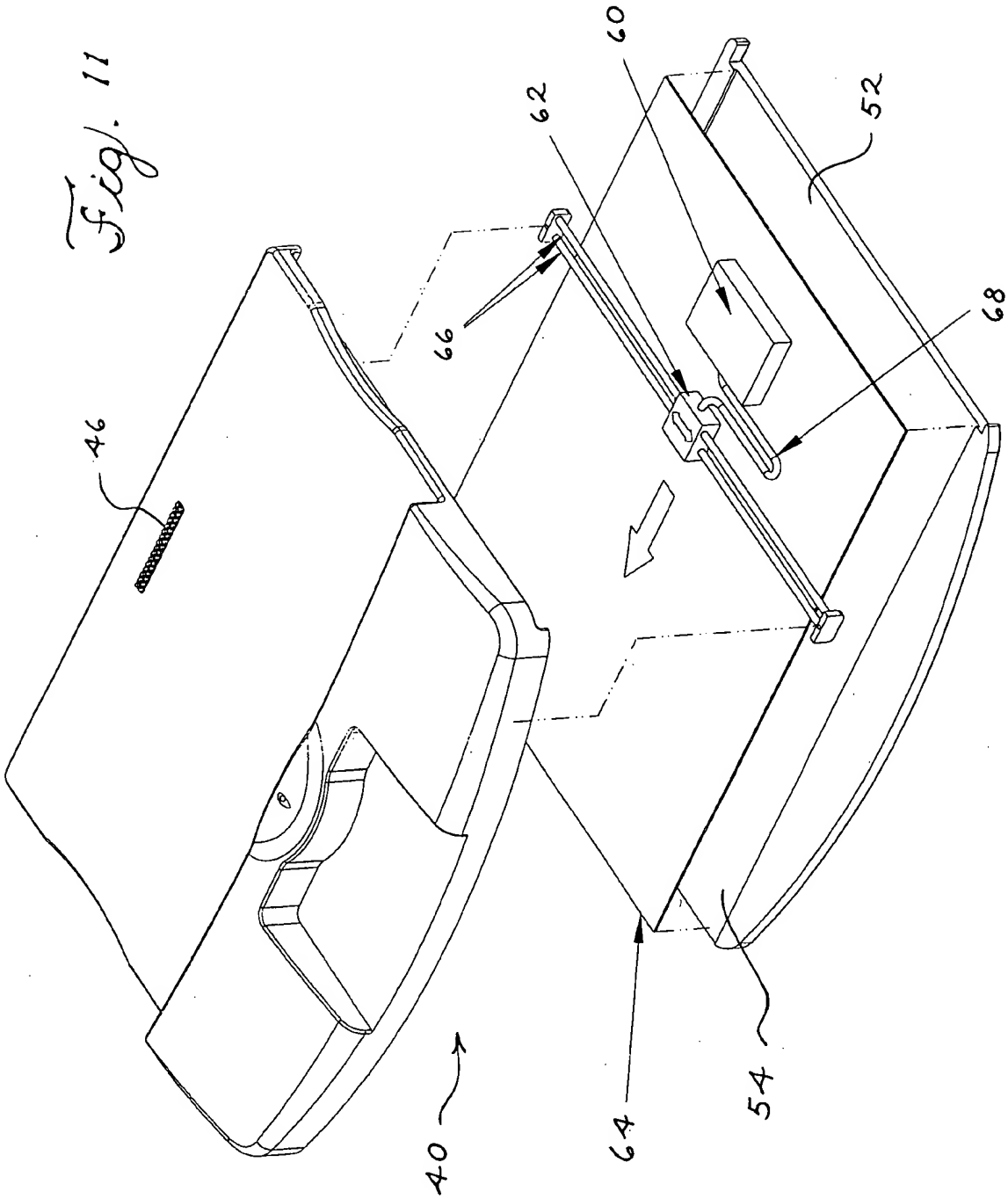


Fig. 12

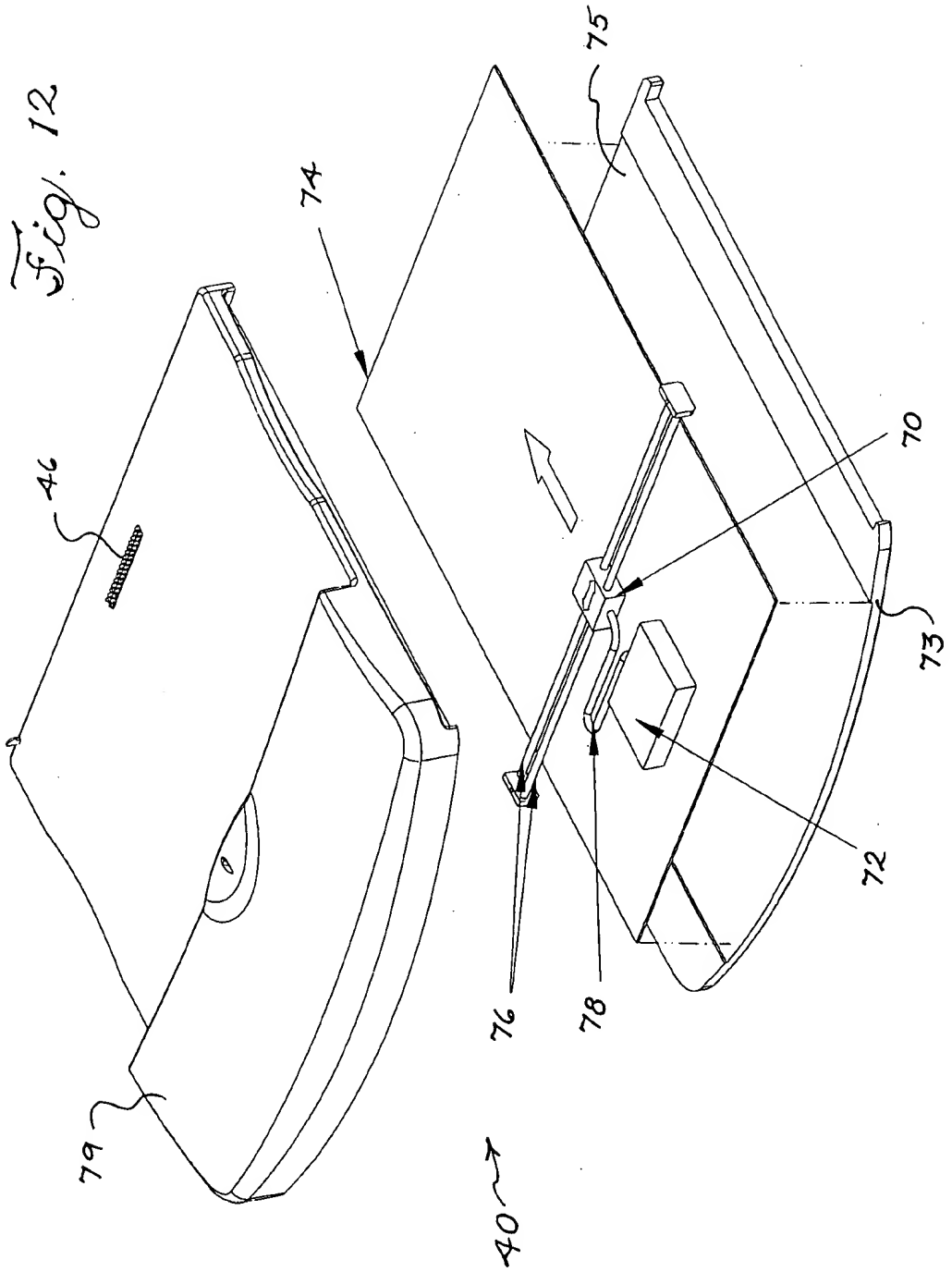


Fig. 13

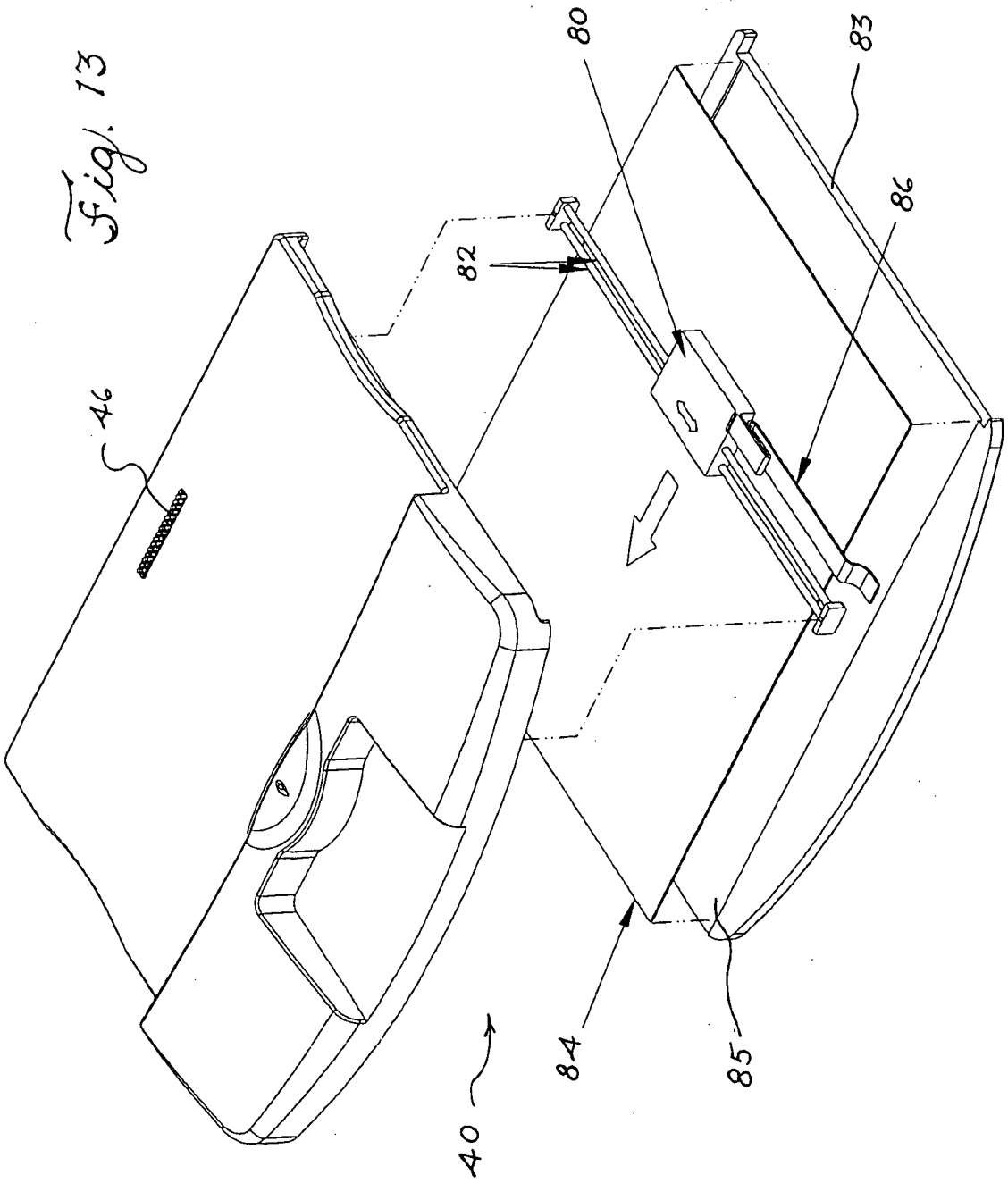


Fig. 14

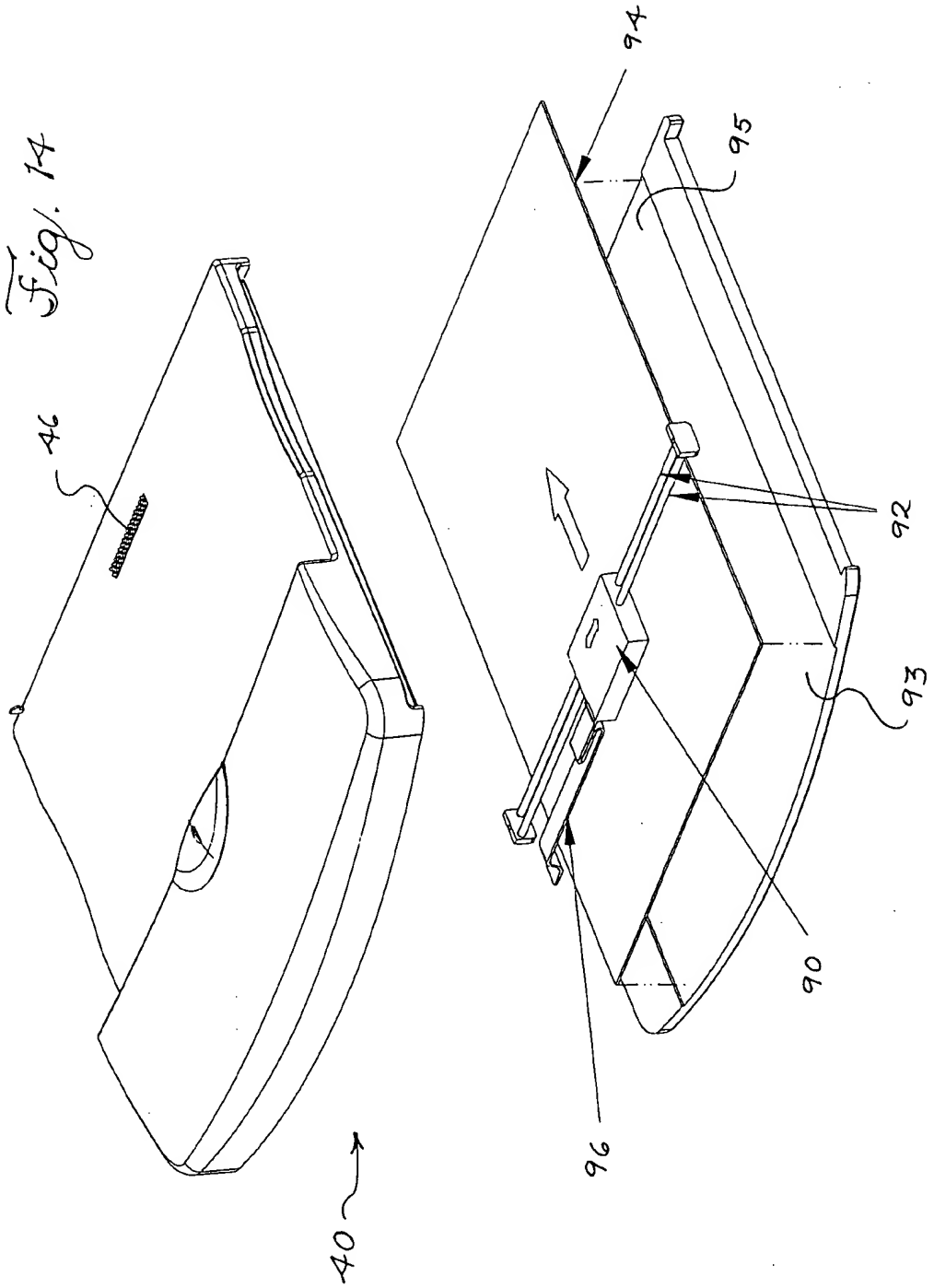


Fig. 15

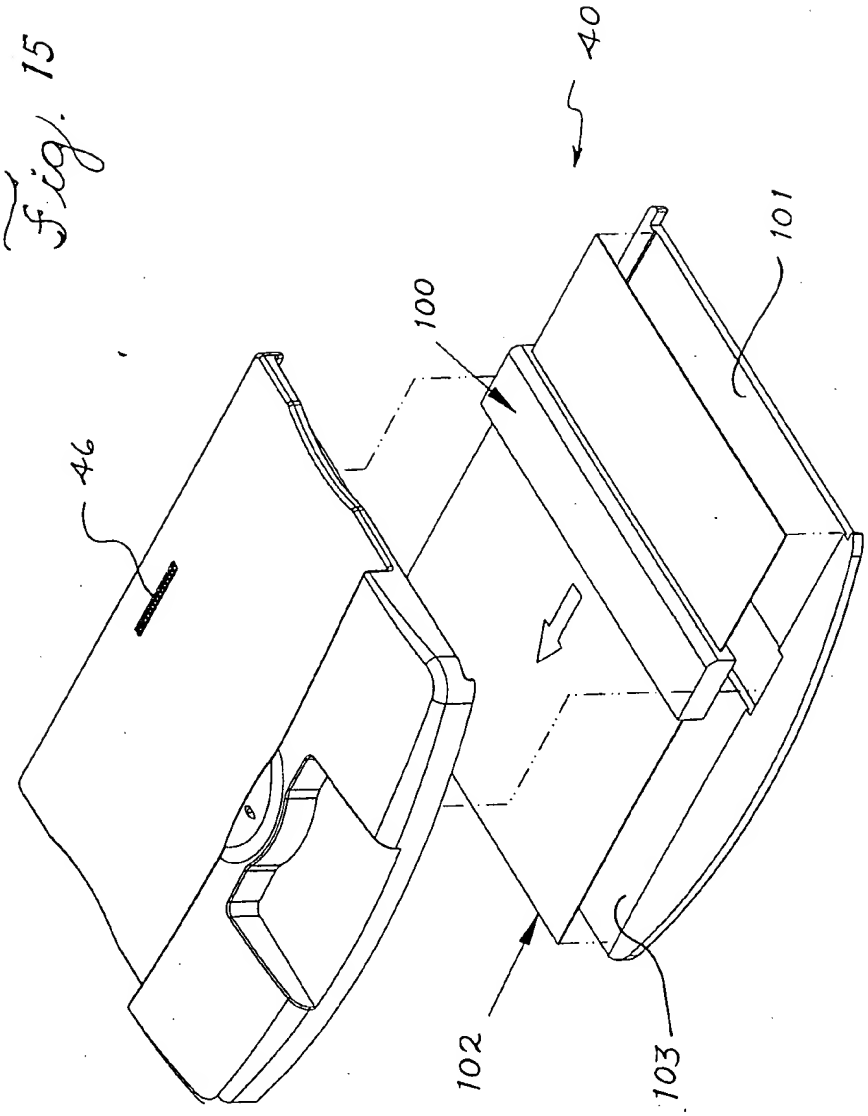
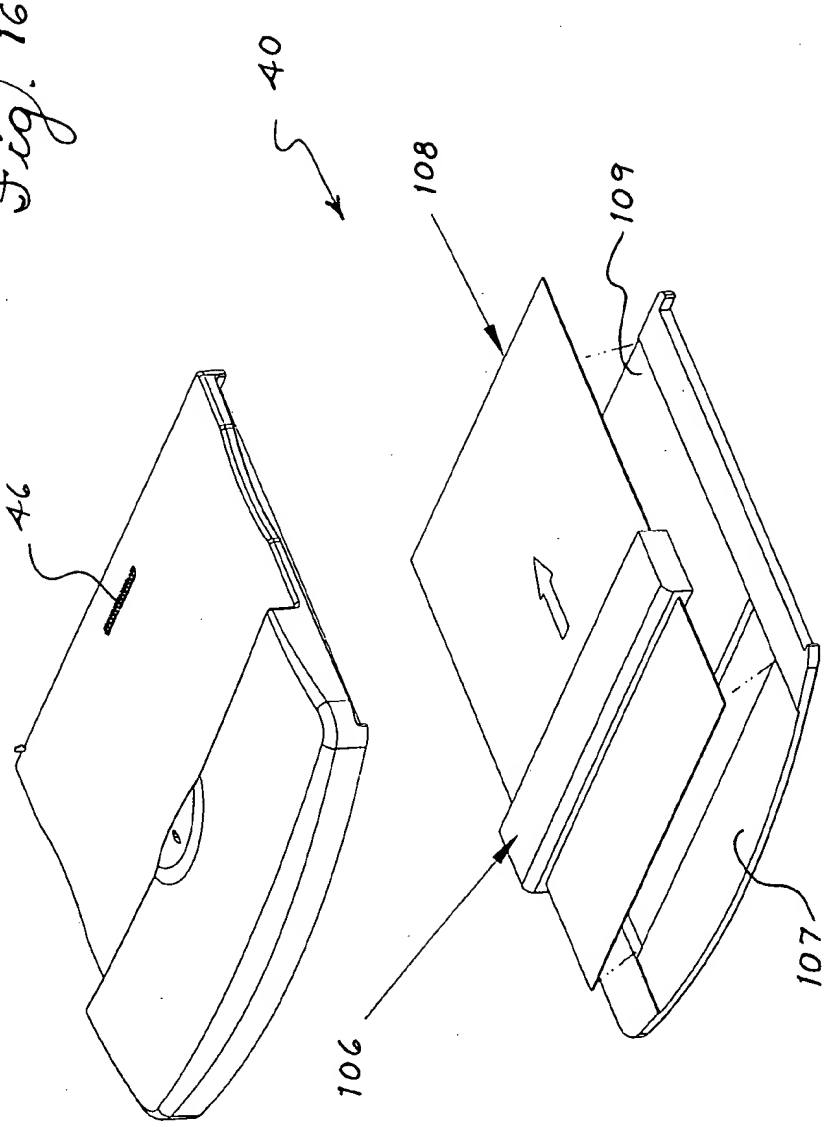


Fig. 16



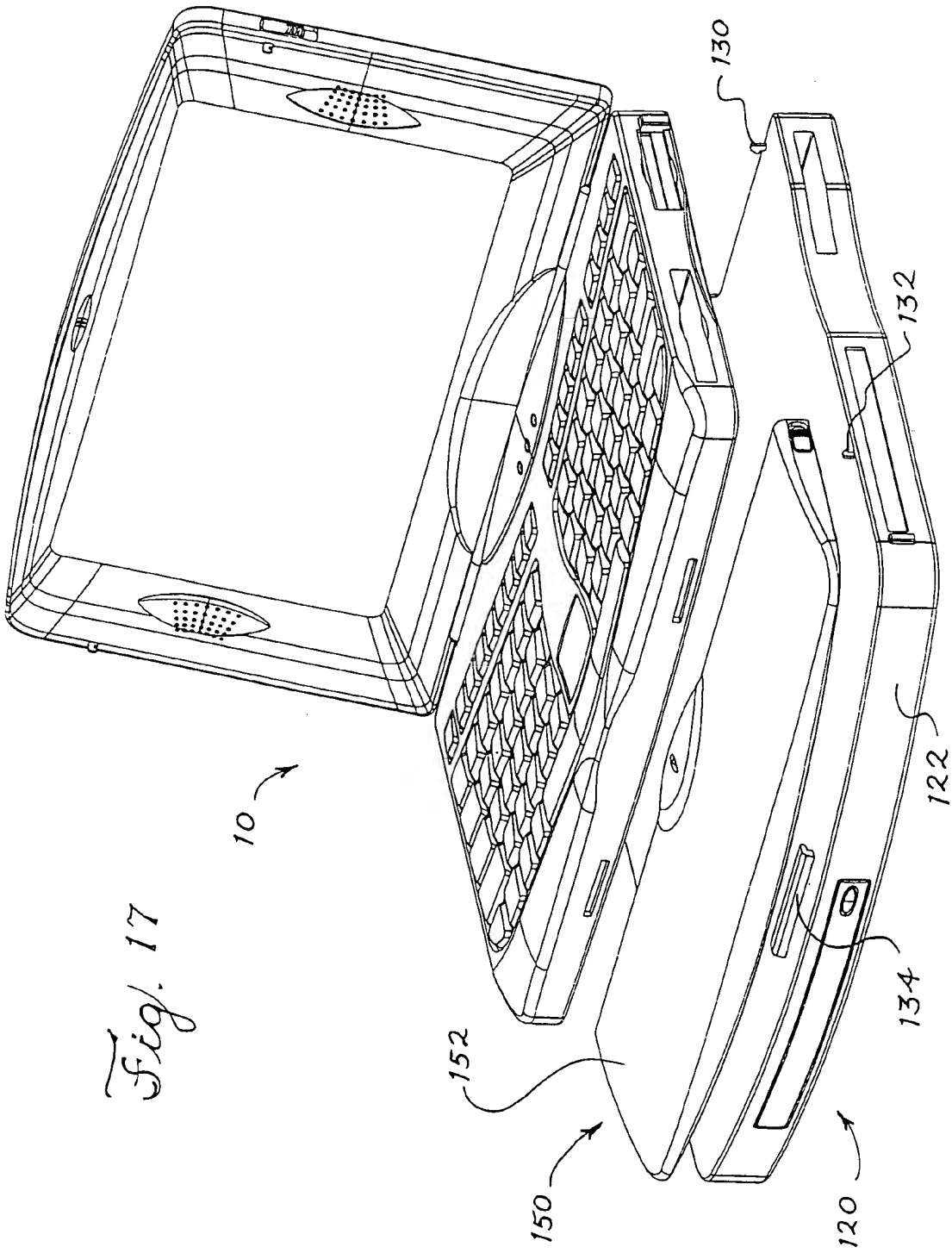


Fig. 17

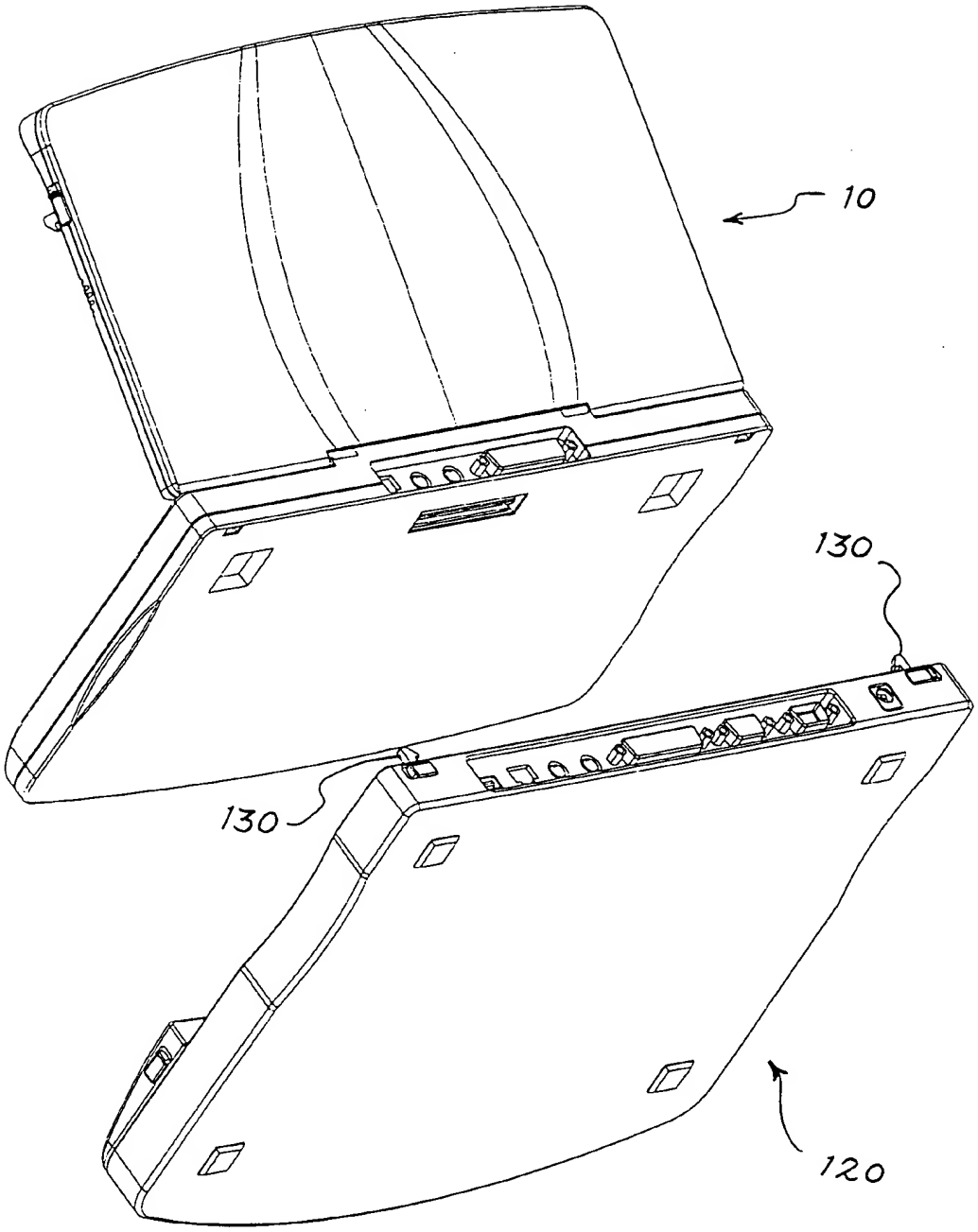


Fig. 18

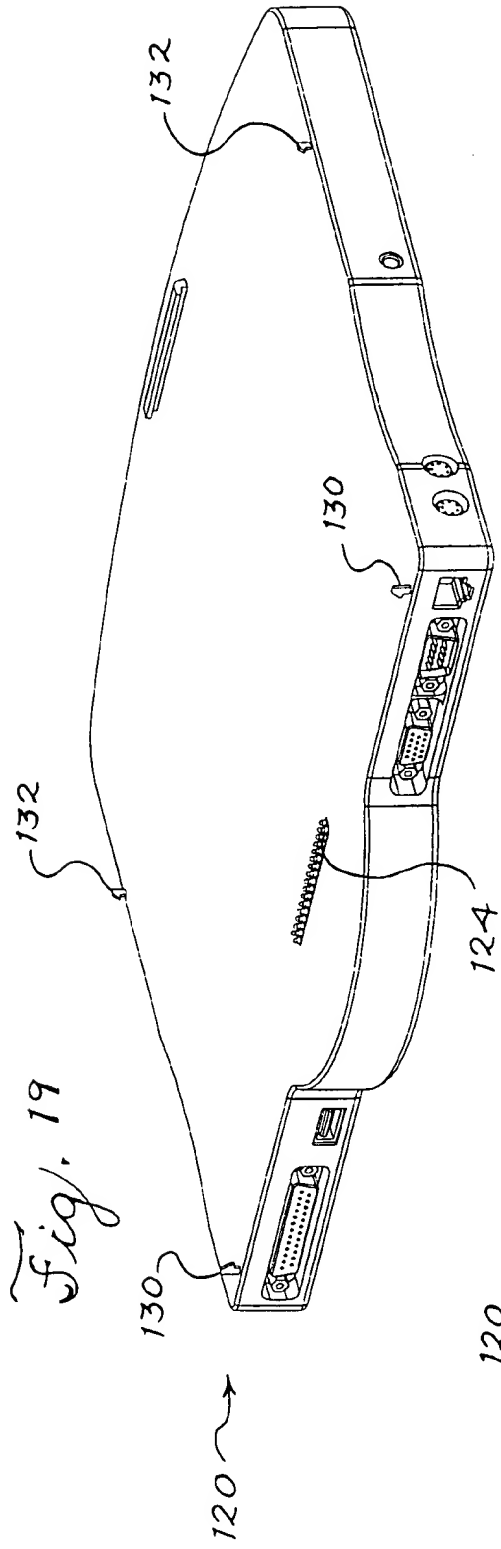


Fig. 19

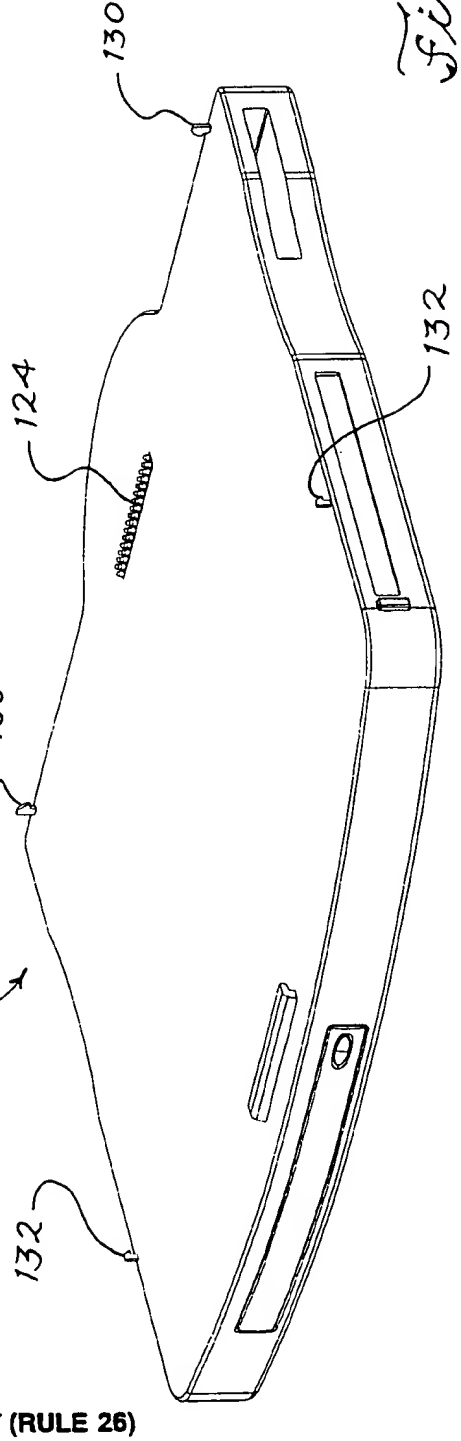


Fig. 20

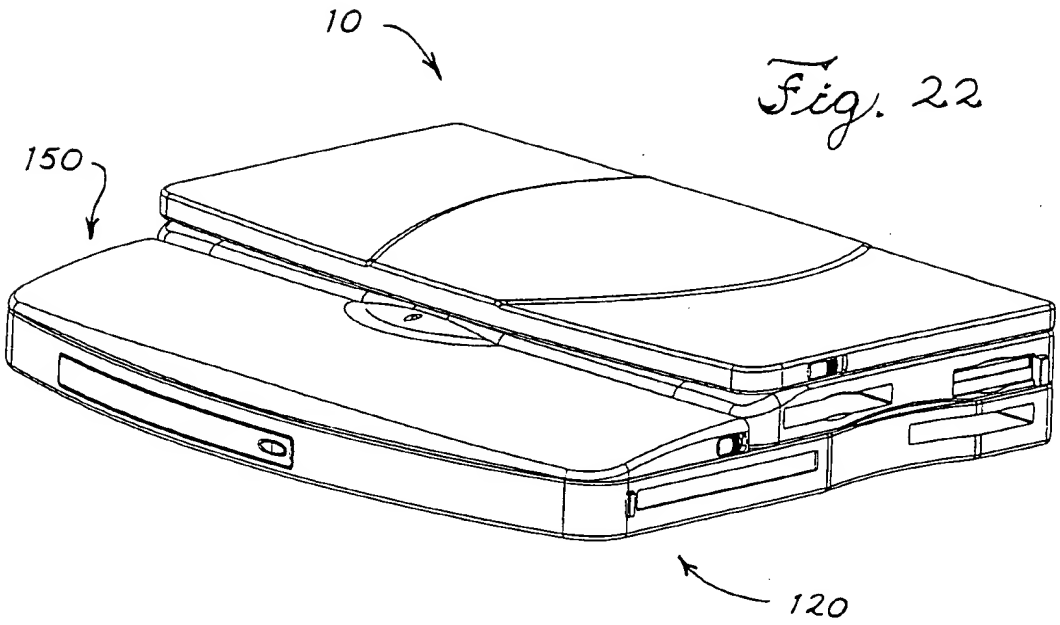


Fig. 22

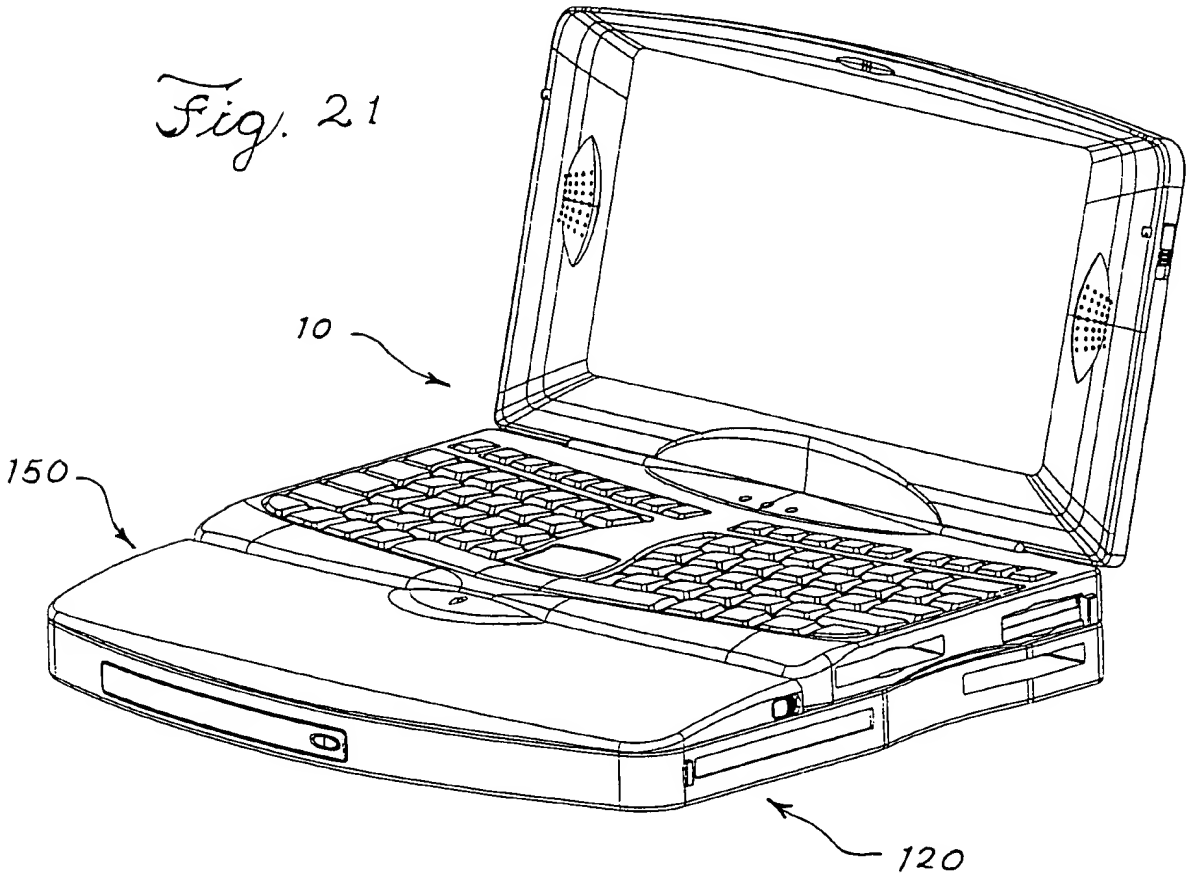


Fig. 21

Fig. 23

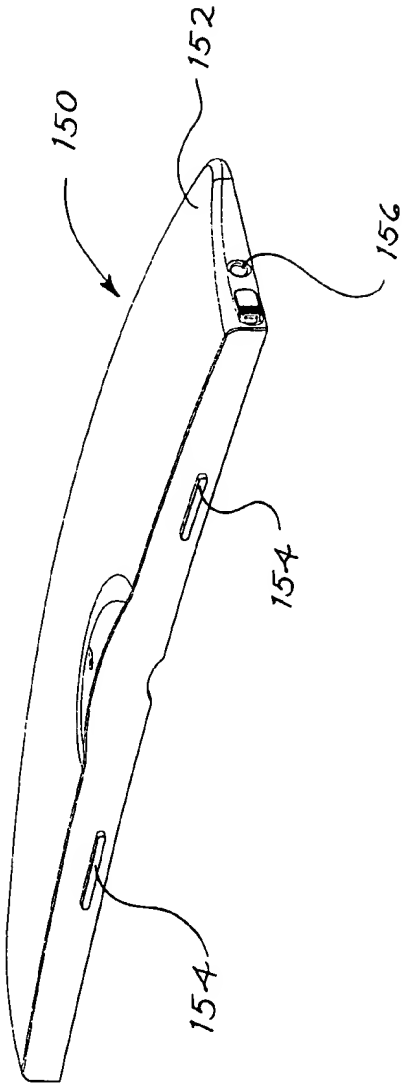


Fig. 24

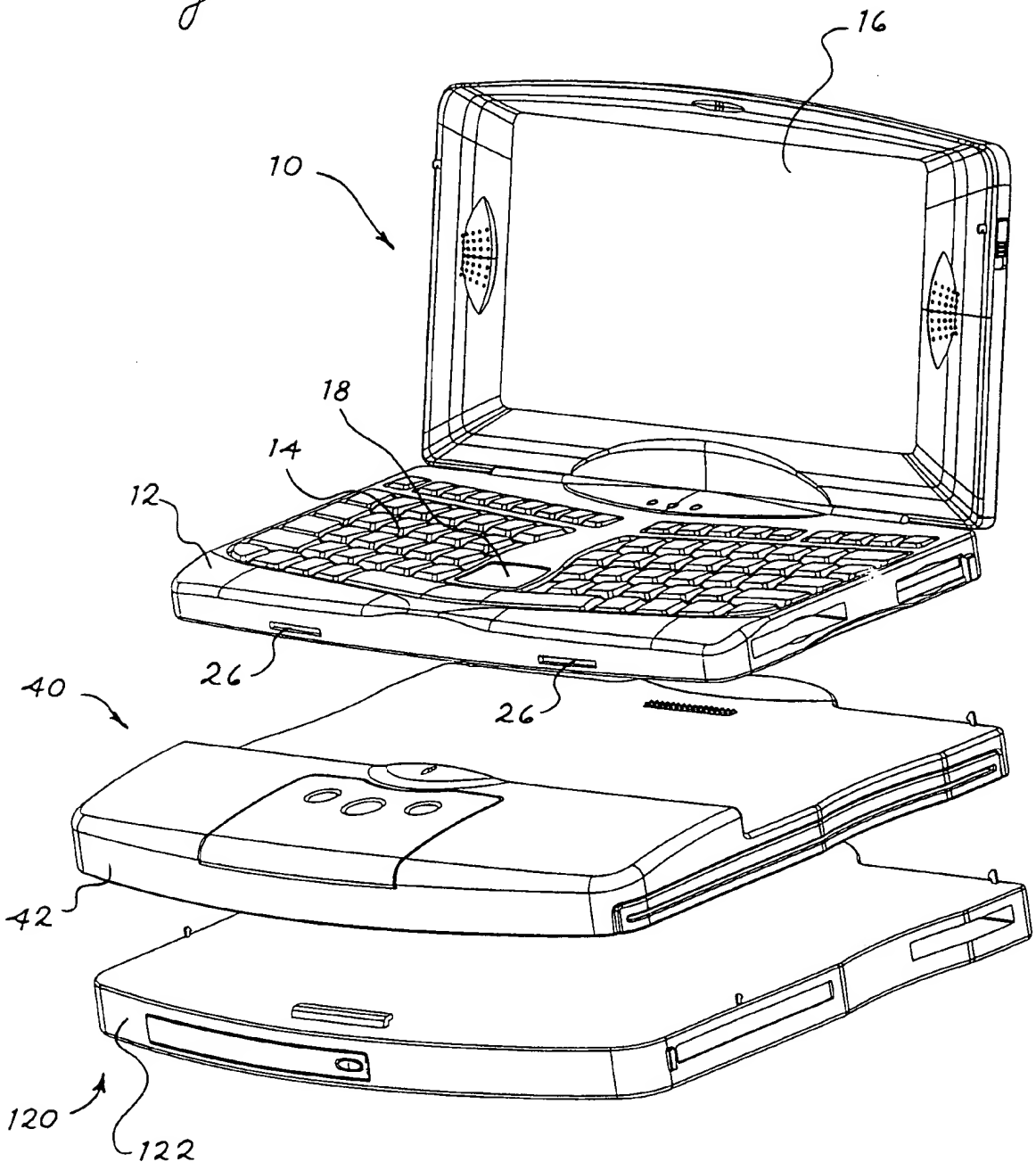
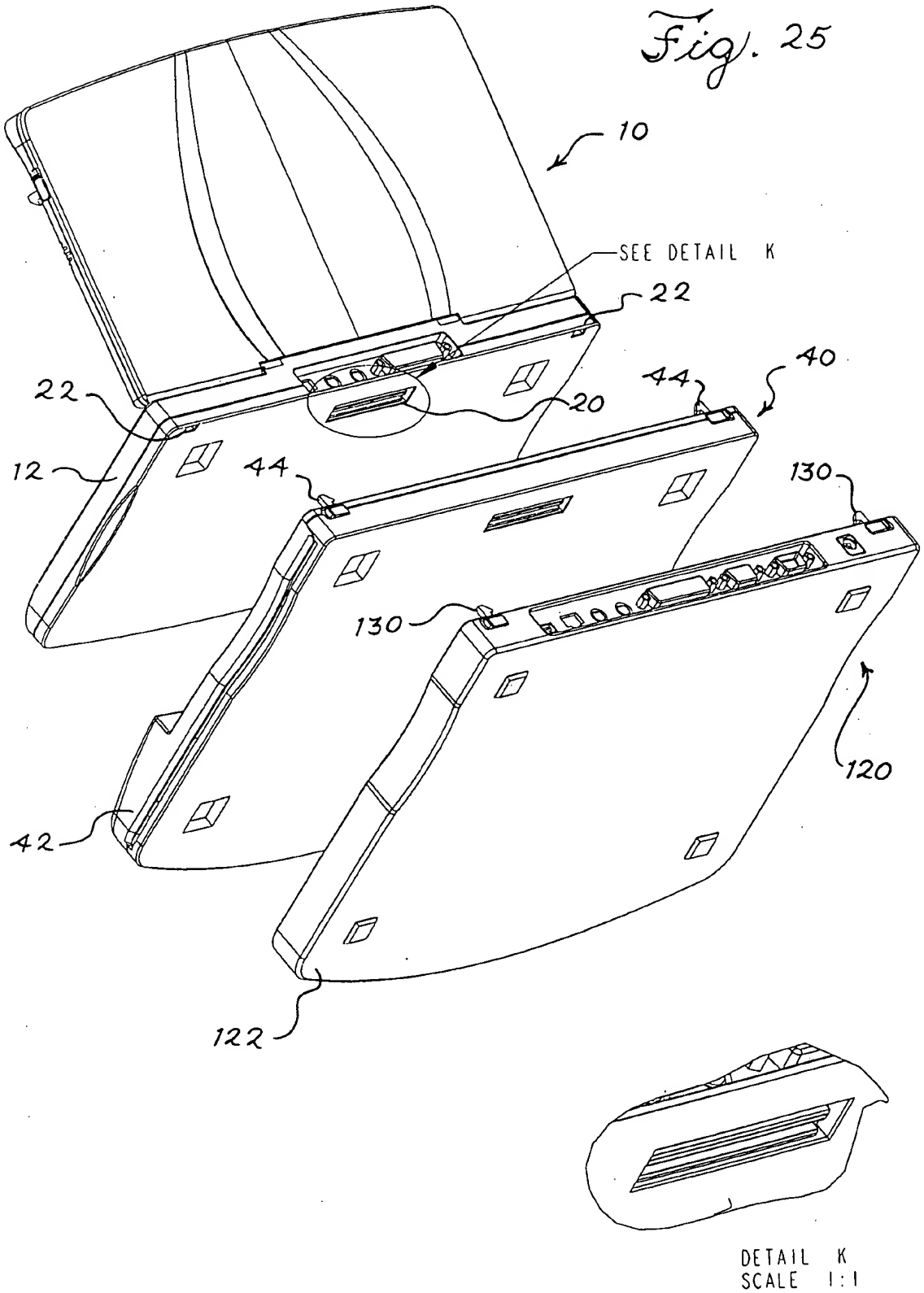


Fig. 25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SCALE 1:1

Fig. 27

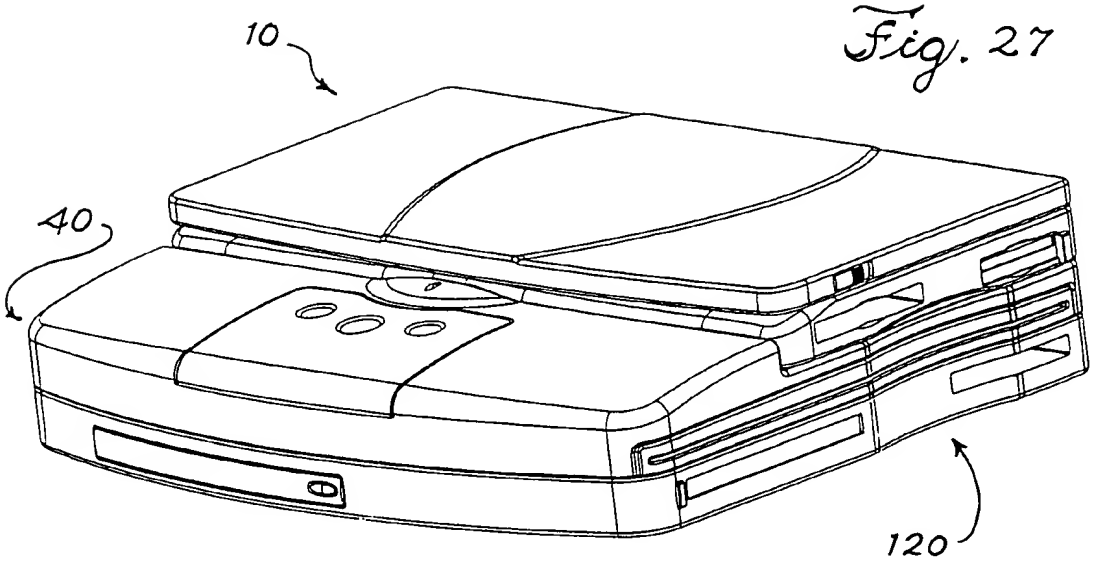
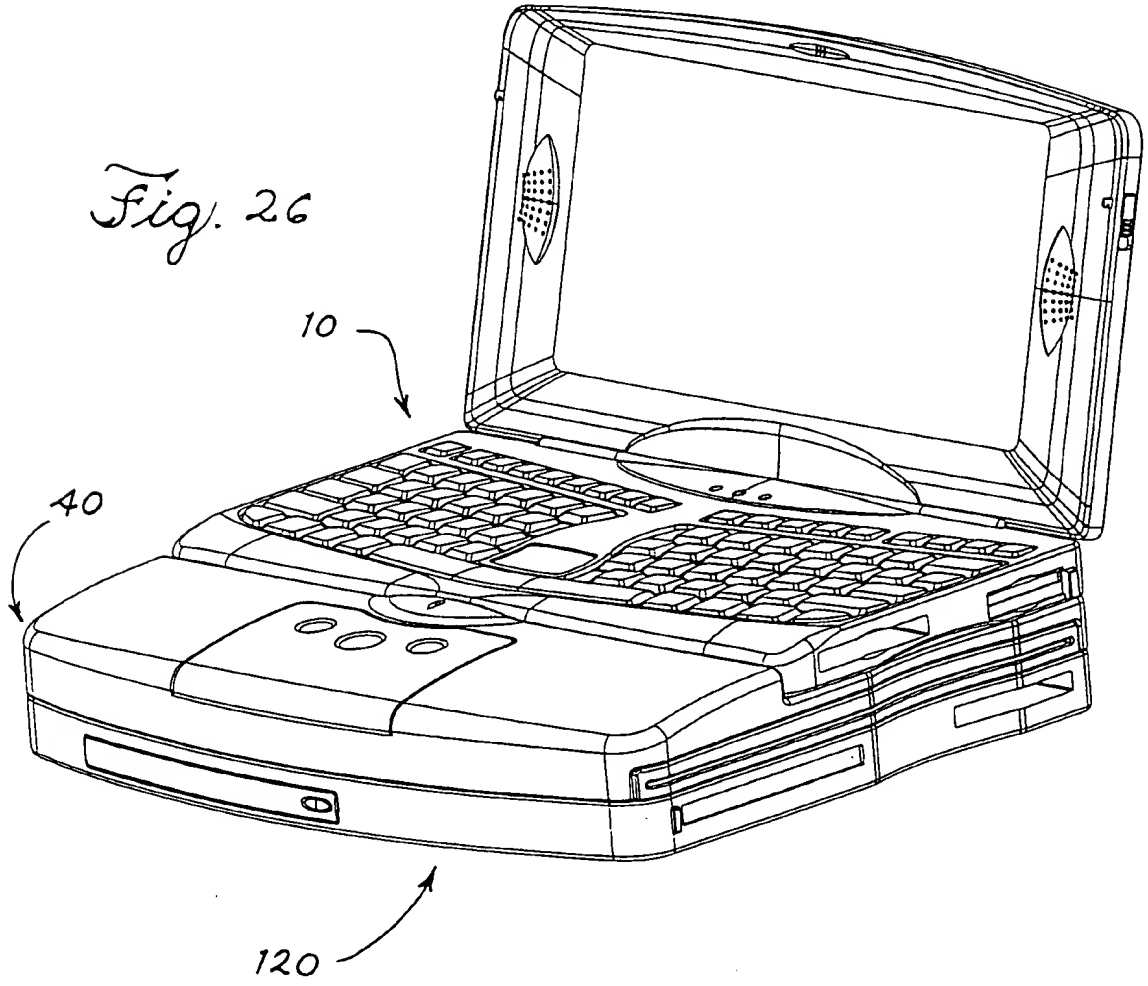


Fig. 26



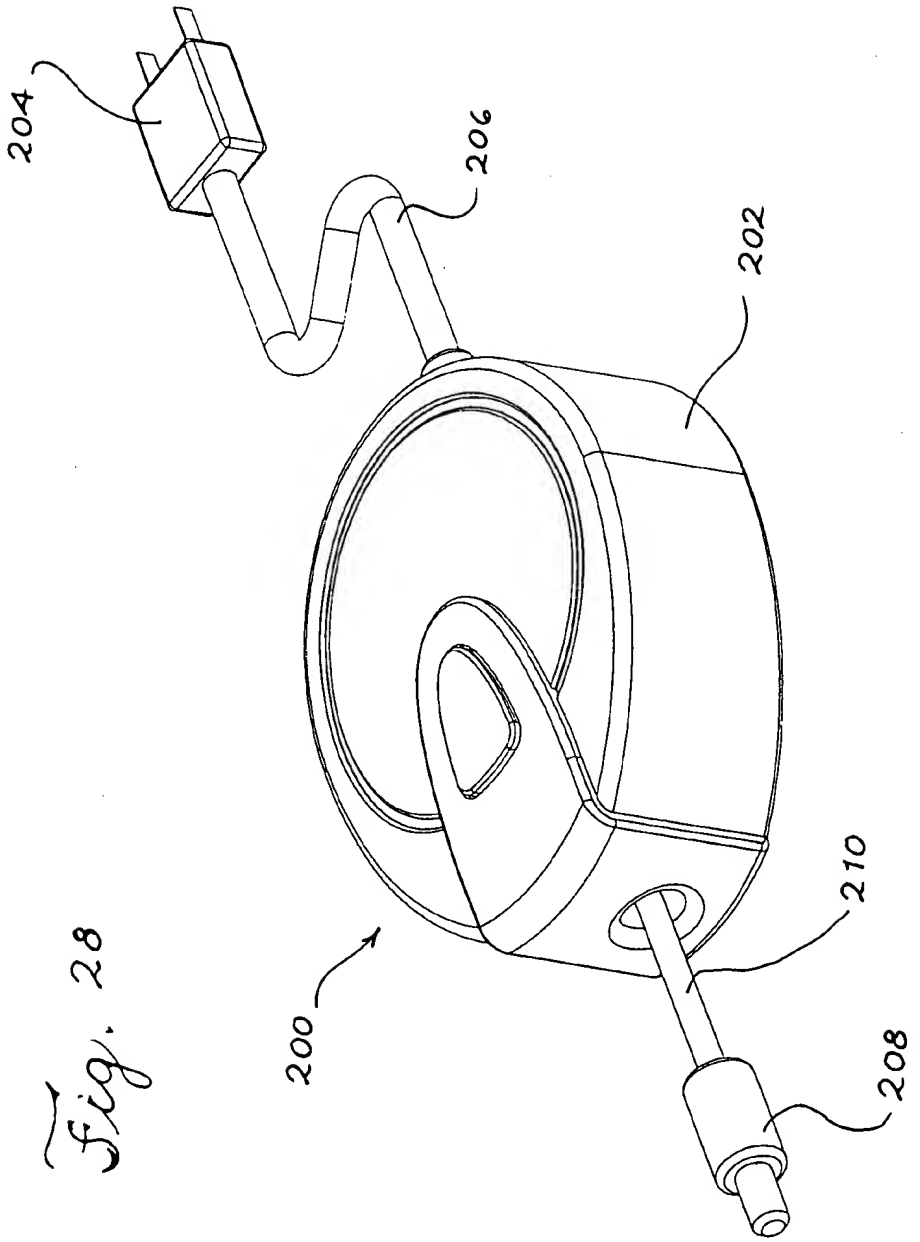


Fig. 28

Fig. 29

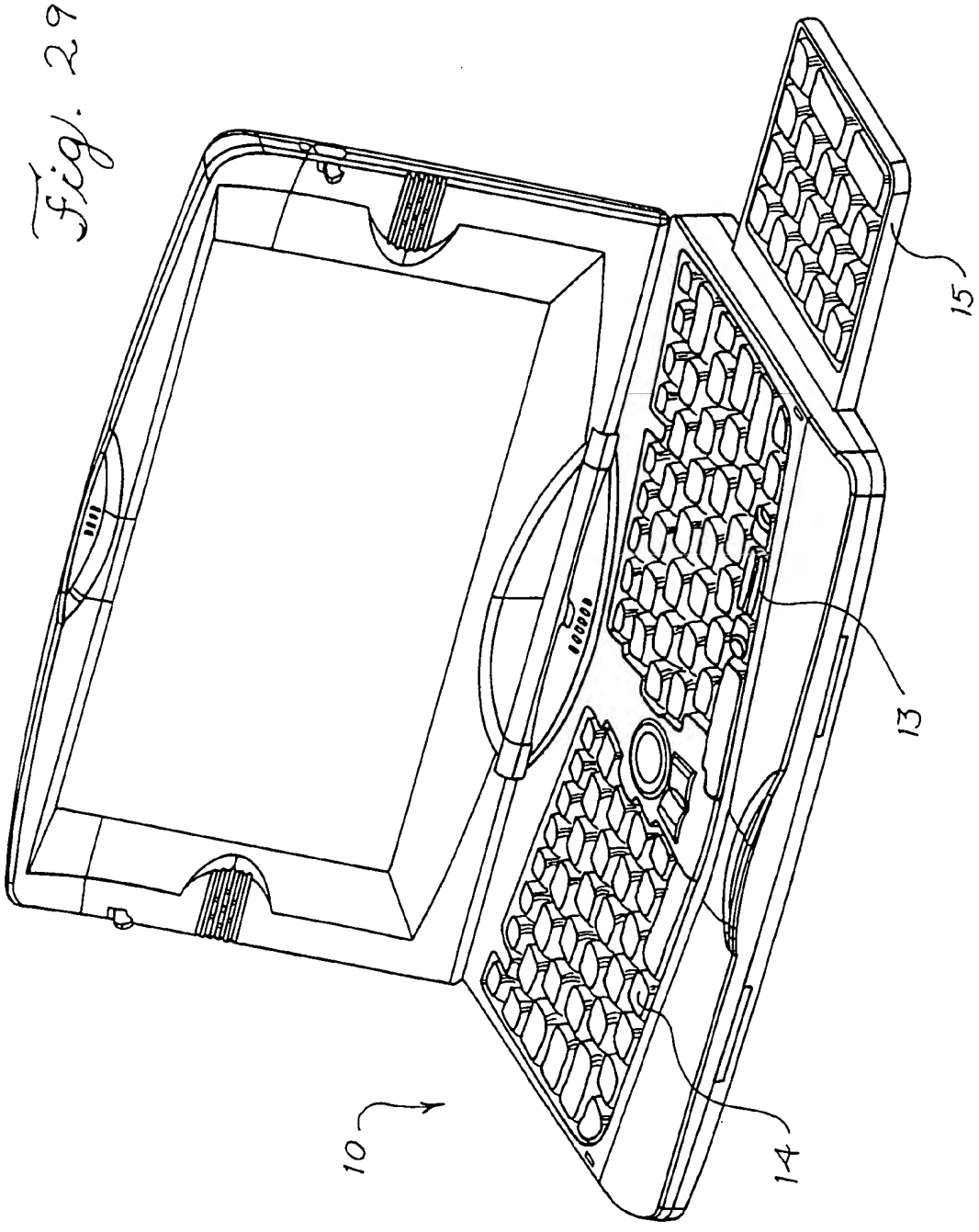


Fig. 30

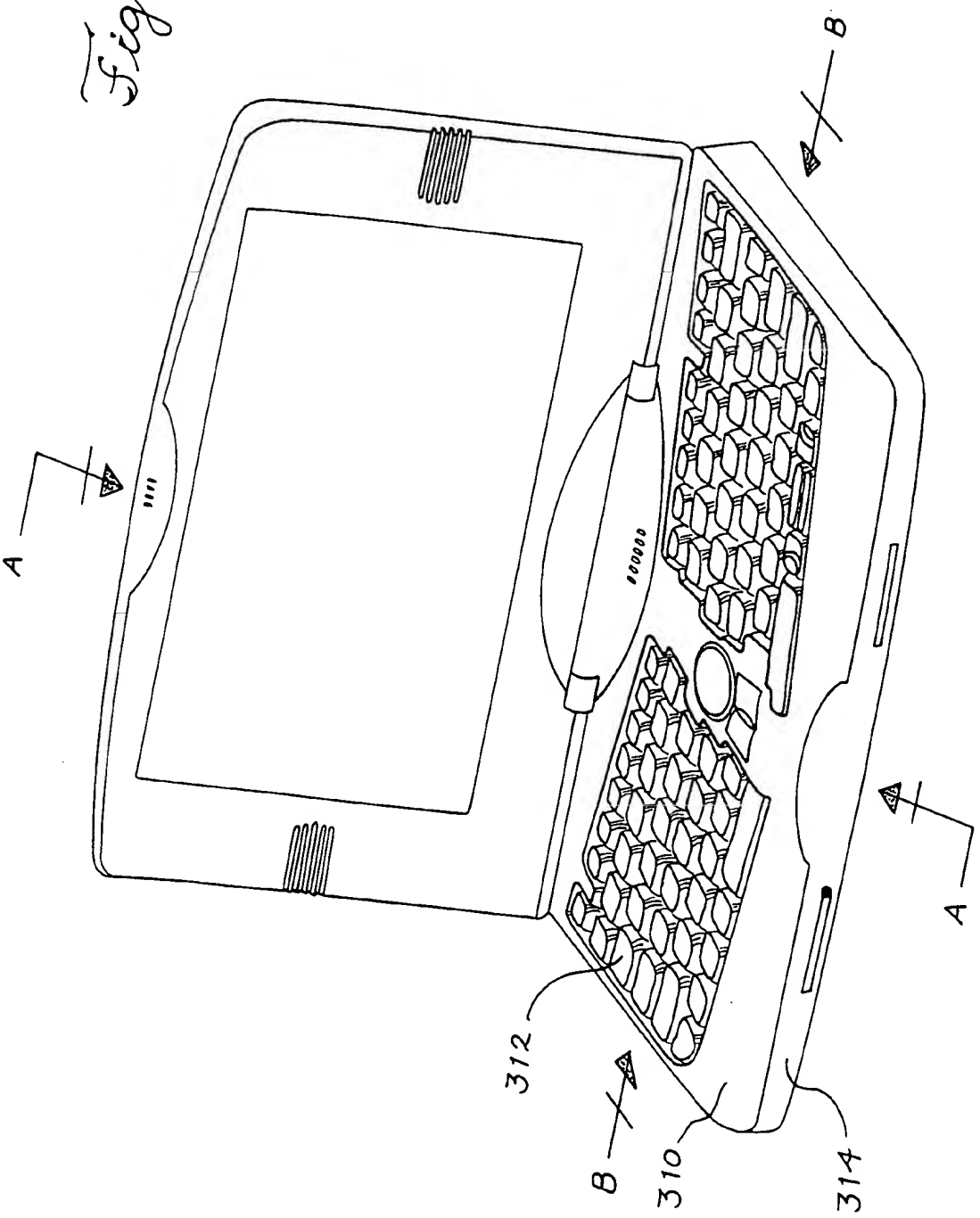


Fig. 32

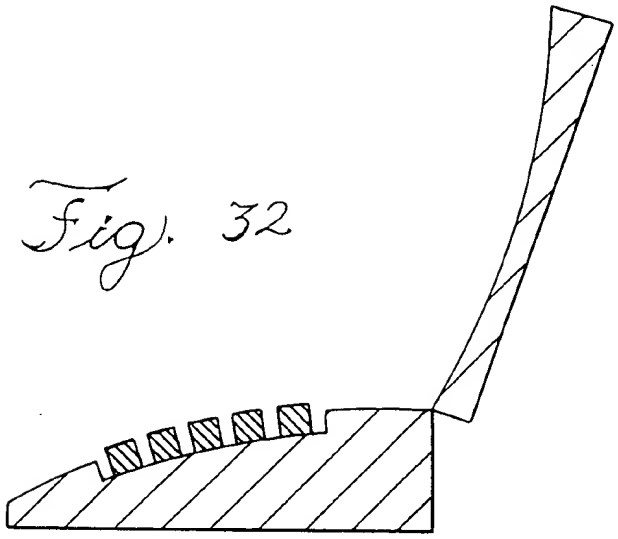
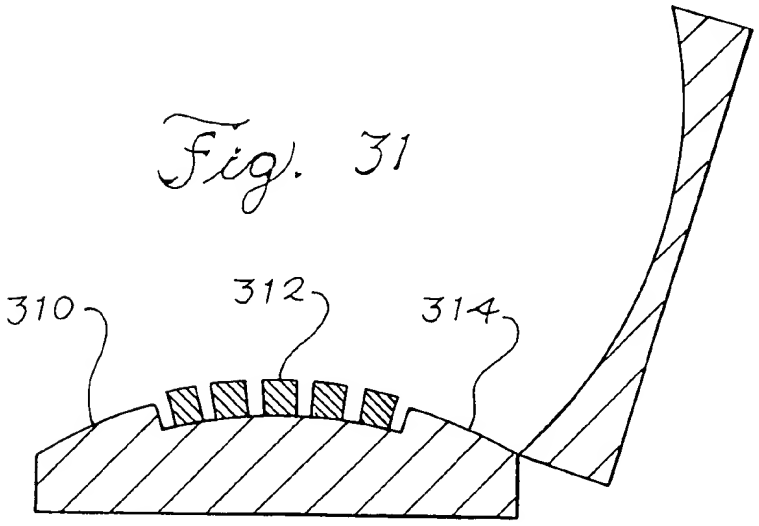


Fig. 31



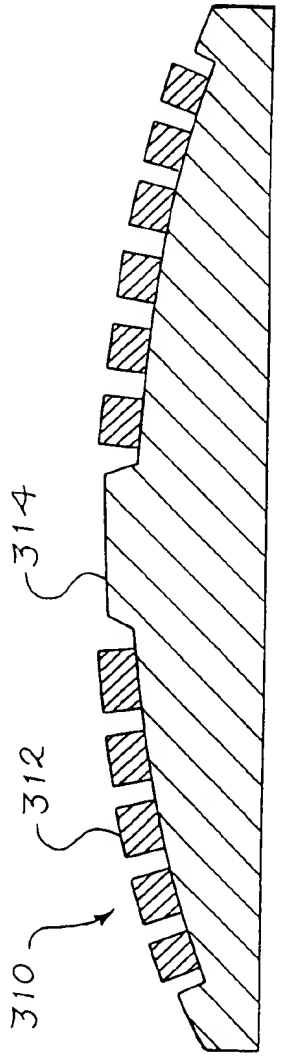


Fig. 33

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/05753

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US 5,793,355 A (YOUENS) 11 August 1998, (11-08-98) in its entirety	11
A	US 5,519,569 A (SELLERS) 21 May 1996, (21-05-96) in its entirety	1-3, 5-10
X,P	US 5,764,474 A (YOUENS) 09 June 1998, (09-06-98) in its entirety	4
A, P	US 5,717,431 A (CHIA-YING et al.) 10 February 1998, (10-02-98) in its entirety	1-3, 5-10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/05753

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 1/16, H05K 7/16, H03K 17/94,G09G 3/02
US CL : 361/680; 364/708.1; 400/682, 488, 489
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 361/680; 364/708.1; 400/682, 488, 489

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	US 5,790,053 A (CHANG) 04 Aug 1998, (04-08-98) in its entirety	1-3, 5-10
X,P	US 5,786,775 A (CHANG) 28 Jul 1998, (28-07-98) in its entirety	1-3, 5-10
X	US 5,490,037 A (CLANCY) 06 Feb 1996, (06-02-96) in its entirety	4
X	US 5,341,154 A (BIRD) 23 Aug 1994, (23-08-94) in its entirety	11
A	US 5,519,570 A (CHUNG) 21 May 1996, (21-05-96) in its entirety	1-12
A	US 5,502,460 A (BOWEN) 26 May 1996, (26-05-96) in its entirety	1-3, 5-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 JUNE 1999	13 AUG 1999

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	LISA LEA-EDMONDS
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Form PCT/ISA/210 (second sheet)(July 1992)*